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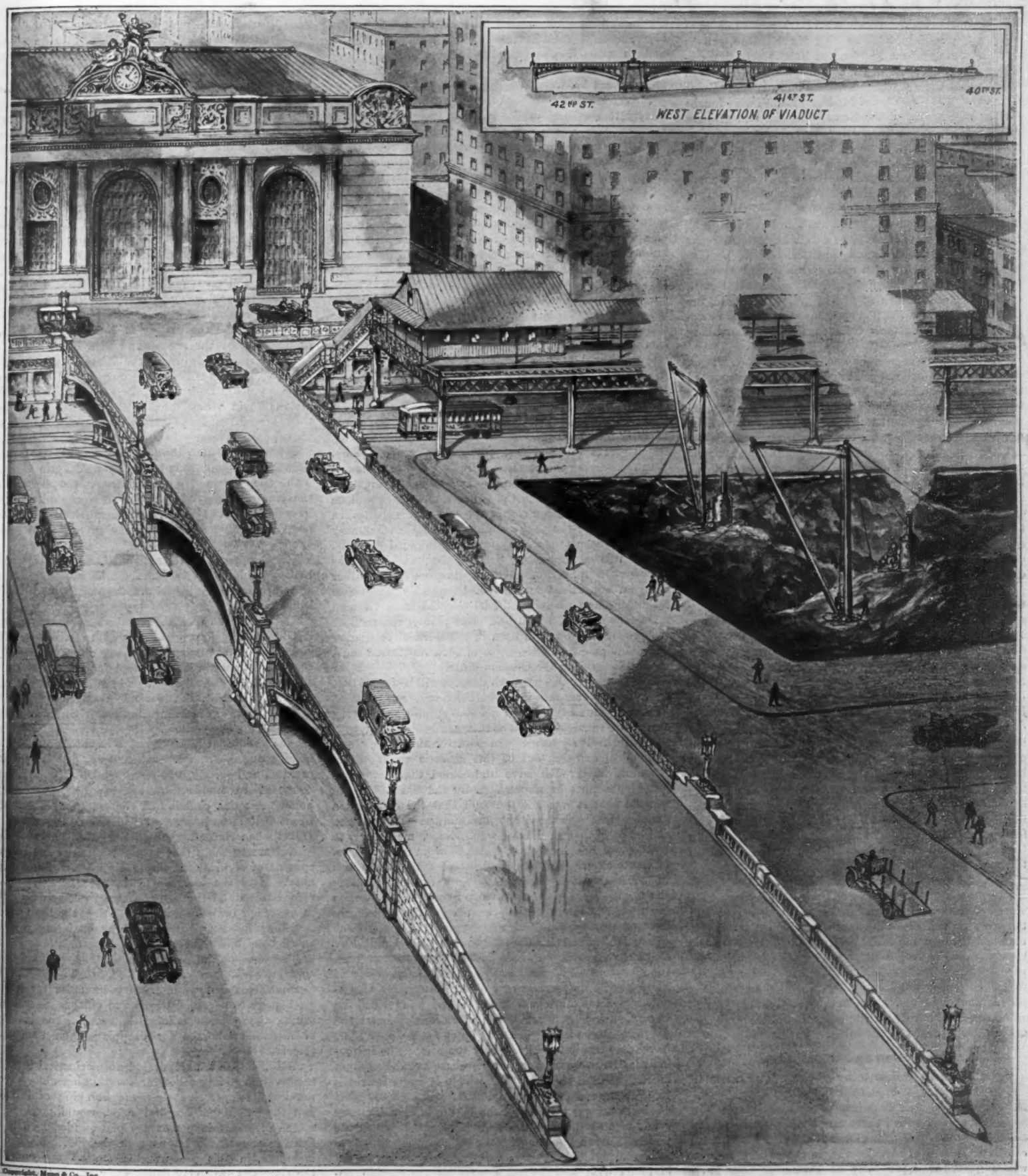

New viaduct leading to the upper driveway around the New York Central Depot [See page 378]

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Redemption of the City of Lille

WHEN the present world tragedy shall have passed into the keeping of the future, and its stupendous happenings have resolved themselves into their true order and meaning, it may well happen that the war will come to be known as the Great Crusade. The Crusades of Mediaeval times were fought for the redemption of the Cross—this last and greatest of them all has been fought for the redemption of that humanity, justice, and charity of which the Cross is the eternal symbol.

In the days to come, when the myriads of citizen-soldiers have been disbanded to return to the pursuits of peace, we may be sure that for each of the several armies of the Entente, there will stand out some one among its many glorious feats of arms, as preëminently significant of the skill of its generals and the valor of its troops.

Belgium will point with undying pride and affection to her little army, which flung itself athwart the path of the German hordes at Liège, and so gave to the French and British the few vital days which were necessary for mobilizing their forces against the onrushing flood of invasion.

For France there will be the Battle of the Marne, where, outnumbered five to three, she hurled the vaunted German army back in total defeat, and caused its hosts to entrench themselves, in sheer defense, half a hundred miles to the rear—for it was thus that France saved our Civilization.

Italy will point to the heroic fighting, under seemingly impossible conditions, among the rugged mountains of the Izonzo region, with its culminating success in the capture of the supposedly impregnable Gorizia.

And we in America shall ever look back with pride to the second battle of the Marne, to Chateau-Thierry and Belleau Wood, where our gallant boys, not to be denied, met for the first time and threw back in bloody defeat some of the choicest troops of the German army.

And for the British, the day of all days, surely, will be that of the pageant in the rescued city of Lille, so vividly set forth by Philip Gibbs (the Froissart of this war in Flanders), when the general of the victorious British army rode at the head of his troops into the public square, and handed his army flags to the bishop and mayor and other dignitaries of Lille, receiving from them in return the flag of the liberated city. For the entrance into Lille will be forever associated with those two weeks of terrific attack, which carried the British through the defenses of the Hindenburg Line and out into the open country beyond. The magnitude of this feat can best be learned from the losses, which ran from thirty-five to forty thousand a week. It was this stupendous and costly effort which snapped definitely and for the first time the chain of German occupation, all the way from Cambrai to the sea, and brought about eventually that redemption of French and Belgian cities, of which the recovery of Lille, was the culminating point.

Lille, the capital of the richest industrial section of France, a city of two hundred thousand souls, was a victim of the war that was well worth redeeming; and the pride in the heart of that war-worn British army, as it marched through the liberated city and listened to the loud acclaims of its people, was the pride of men who, with the true Crusader's spirit, had marched, suffered, fought, and bled, not for military fame, not for material plunder, not even for a "place in the sun" but, in common with the rest of our Crusading hosts, to defend humanity and establish justice on the earth.

"Restitution and Reparation"

A PARTIAL estimate by Belgian authorities of the damage done to Belgian industries, cities, villages, etc., runs into billions of dollars; but, so far as we are aware there has been no close official estimate, upon which claims for restitution and reparation can be based. Not so, however, in the case of France, whose government, as early as December 23d, 1914, began to take official cognizance of the destruction, and enunciated the principle that any war damages should be a charge on the French nation as a whole.

Now, according to statistics drawn up under the auspices of the French government, and published by our Department of Commerce, in the invaded Departments of France alone there were nearly 26,000 factories and industrial establishments, representing more than 30 per cent of the industrial output of all of France. From these districts was furnished 90 per cent of the iron ore produced in France; 83 per cent of the pig iron, 75 per cent of the steel, 70 per cent of the coal, 94 per cent of the combed wool, 90 per cent of the linen thread, and 64 per cent of the sugar. Information as to the condition of these industries has been furnished by workmen, engineers, and superintendents, who had gradually worked their way back to Paris, and they have established the fact that in many localities and industries literally nothing remains.

Coal mines have been flooded and it will take years to put them in working order; electric power stations and their transporting lines have been dismantled, the machinery carried away, and the copper wire sold; the equipment of metal-working plants, and all the linen, cotton, and wool-spinning machinery has been systematically pillaged. Steel structures have been taken down and the sheet iron roofs and steel structural work sent back to Germany or used in the war zone. Sugar refineries have been completely destroyed.

It is evident that it was the policy of Germany not merely to steal everything she could use or turn into cash, but also deliberately to destroy the very industries themselves and so be in a position, industrially at least, to carry on the war against the invaded peoples, even after peace had been declared.

By way of getting at some estimate of the financial loss represented by this destruction, the French have taken as a basis the cost of construction before the war of a few of the industries of Northern France that are known to have been the greatest sufferers. Our commercial attache in Paris, Mr. Pierce C. Williams, states that this estimate comes from a trustworthy and semi-official source. The list includes twelve of the industries, including the various textile industries; the electric stations, machinery and electrical plants; the coal mines, iron mines, blast furnaces, and steel works. The total estimated cost of construction of these plants is over five billion francs, that is to say over one billion dollars. But because of the great increase in prices (which is chargeable to the German assault on the world at large) the cost of replacing these industries today is conservatively estimated as nearly three times the original cost, which brings the total sum up to three billion dollars.

In considering the methods of restitution, there is one which is so obvious and ready-to-hand that it must inevitably be written into the peace terms which will be imposed upon a beaten Germany; and that is the return by Germany of the vast amount of valuable machinery which has been taken away from the invaded districts. Where this is impossible, because the machinery has been broken up, melted down, or disassembled for other uses, an equivalent amount of thoroughly up-to-date machinery and plant should be selected from German mills, factories, and coal and steel plants, returned to the invaded region, and used in the work of rebuilding and reëquipment. The justice of such restitution must be evident even to the German mind.

But even after this has been done, it will be found that an enormous amount of rebuilding and reëquipment from the ground up will be necessary; and already the owners of these industrial plants are coöperating with the French Government in a plan for the orderly and economical carrying out of this gigantic work. From the first, the French have understood that a task so formidable must be undertaken by the State. It was realized that it was not the cash that the owner of a damaged factory wanted but merchandise—bricks, steel, and mortar to construct new buildings, machinery to fill them, raw materials with which to begin manufacture. It was realized that the payment of cash indemnities to thousands of individual manufacturers would produce the fiercest kind of competition and an immediate rise in prices. Evidently the thing could be efficiently handled only by a central bureau; and the government wisely determined that the task could best be handled by a private organization of the manufacturers themselves, conducted without profit, and serving as the proxy of the State in the purchase of needed materials. Consequently, in the latter part of 1915 there was formed the Central Association for the Restoration of Industrial Life in the Invaded Regions, which comprises over 1,000 of the manufacturers affected by the war. The following year an association for the purchase and distribution of merchandise was formed, which is known as the Central Bureau for Industrial Purchase. The support of the State was insured by the voting of a preliminary credit of 50 million dollars as a fund out of which the Central Bureau would make its purchases.

American manufacturers will, of course, wish to get in touch with the Central Bureau at the earliest opportunity; but it has intimated that there would be little use in having individual American manufacturers send catalogs, just now, to the Bureau or correspond, with a view to taking orders later on. The problem is too huge for individual and competitive buying. The Bureau considers that it will be out of the question for isolated American firms, however large or well-equipped, to meet the demands. It is with groups of American manufacturers—each group capable of supplying a certain industry in the invaded district that the Central Bureau wishes to establish relations at this time.

Inventions—Allied and German

IN a comparison of the inventive genius of the Entente and the Central Powers the balance is overwhelmingly in favor of the Entente Allies, as the following brief tabulation will show.

On the testimony of the German commanders themselves, the most decisive of the new weapons of attack is the tank, designed by the British. The motor-driven airplane, an American invention, was put to military use by both sides at the opening of the war; but its early development was due to the French. They were the first to mount the machine gun, and with the British, except for one brief period, they have led in the matters of speed, maneuvering ability and all-round efficiency.

Save for the production of the heavy semi-mobile howitzer and the long-range gun, the Allies have led in gunnery. The British introduced drumfire at Neuve Chapelle; the French developed first the stationary and then the creeping barrage (rideau de feu) at Verdun. To the French, also, we owe the location of guns by sound; and the Allies were the first to make use of heavy, long-range guns mounted on railroad cars. The Maxim heavy machine gun has remained until recently the single type used by German troops; for the Allies were the first to use the light, portable machine gun, the British adopting the Lewis gun, the French the light Chauchat, and the Americans the Browning.

The Germans entered the war with a small trench mortar, the minenwerfer, and their attempts to improve upon it have failed; but the Allies have shown remarkable fertility in this field, as witness the portable Stokes mortar of the British, which can be carried on a man's back and the variety of hand and rifle grenades brought out by the French and British.

The Germans, thrown on the defensive, developed the pill-box; but the Allies at once countered by mounting heavier guns in their tanks, the French even using their famous 75 in a new tank of their own design. Later they brought out the small, fast tanks, which have contributed so largely to the German defeat. When the war was carried into the open last spring, the Germans showed a small hand-drawn field gun for use with the storm troops. It was too heavy, and the troops, disgusted, left the piece behind. But the French built a 1½-inch piece, much lighter, which has done yeoman service in the present great counter offensive.

The Germans experimented with body armor; and the British brought out the shrapnel helmet. But German body armor went into the discard and they adopted the helmet.

The submarine, which the Germans have made an instrument of piracy, has served to stimulate Allied invention more, perhaps, than any other agency of the war. So far as we know, except for its increase in size and speed, the U-boat reveals no fundamental, no radical improvement over the original American, French and Italian types. It is in meeting the frightful emergency presented by the German resort to wholesale murder on the high seas, that the Allies have risen to great heights of inventive genius. The British developed the "blimp" or small and speedy, two-man dirigible, the fast motor-boat (550 of them being built in America), and the depth bomb; America contributed the seaplane; and France, Great Britain and America, the listening devices.

But when Germany turned from the legitimate fields of warfare to those that are forbidden by the common consent of civilization, she displayed a striking originality. Here she had the field all to herself, and her record will stand through the ages to come as a monument to her lawless ferocity. To date the list includes:

1. The loosing of clouds of asphyxiating gas, calculated to kill with the most excruciating torture. 2. The discharge of gas shells. 3. The spraying of the enemy with streams of liquid fire. 4. The providing of German troops with incendiary grenades for quickly setting fire to occupied towns and villages, as was done during the occupation of Belgium. 5. The invention of incendiary bombs for dropping upon undefended towns.

And although it necessitated no mechanical inventive faculty, it certainly called for a certain ingenuity of cruel reasoning to perceive that the bombing of hospitals and the sinking of hospital ships, would preclude the return of a certain percentage of wounded men to the fighting ranks. So let us give the Devil his due by including, in this present enumeration the fact that the Germans are today deliberately killing the sick and wounded as they lie in their cots.

Industrial Efficiency

Speeding Up Marine Engine Assembly.—Slow production of marine engines and power equipment for completed hulls, occasioned by many ungovernable factors, has been one of the chief causes of delay in getting numerous completed hulls into service to relieve the pressing need for cargo vessels in the transport of troops and supplies to the battlefield, but occasionally there are bright spots on the horizon. One of these is the feat of the Sun Shipbuilding Company of Chester, Pa., in erecting a complete marine engine of 3,000 horsepower in 15¼ hours, cutting the average time from 30 to 35 per cent.

Government Control of Chlorine.—Owing to the shortage of chlorine in the United States, the War Industries Board, with the approval of the President, has passed a resolution taking over control of its production and distribution. For the present, however, the board is doing no more than allocate the product, and this is being done under the direction of H. G. Carrell, Chief of the Alkali and Chlorine Section of the War Industries Board. Chlorine has a wide range of uses, the most important from the present Government point of view being in the manufacture of gas shells and in carbon tetrachloride, which is the basis of one of the most effective smoke screens and also of the best fire extinguishers. One of the most important commercial uses of chlorine is in the bleaching of paper and various cloth fabrics.

Increasing the Evaporation in Boilers.—In the *Journal* of the American Society of Mechanical Engineers reference has been made to a device developed by C. Hering, which is said to increase considerably the evaporating capacity of boilers. According to Mr. Hering's theory, there exists outside the boiler-plate a thin film of gas, which is formed whenever a flame plays on the outer surface of an evaporating vessel, the liquid inside being at a very much lower temperature than the flame. Such a film offers an enormous resistance to the passage of heat. Thus, if the flame temperature is 1,300 degrees C. and that of the water 100 degrees C., there is a fall of 1,200 in the film, which is estimated to be not more than 0.005-inch thick. This resistance, it is stated, can be diminished by forming lugs on the flame side of the boiler surface, their length and diameter being such that their ends approach a dull red heat. The best dimensions and spacing for such lugs are discussed in detail. Tests have shown that the rate of flow of heat through the base of a vessel provided with lugs was 27 times as high as in a vessel without lugs.

Mechanical Appliances for Wounded Soldiers.—There is a constantly increasing demand for tricycles and motor cars, besides other mechanical appliances, for men who have lost limbs during the war. The future possibilities for the sale of this class of goods for wounded soldiers and sailors can not at present be accurately gaged, though the demand will probably reach into the thousands. It is estimated that in Great Britain alone from 500,000 to 1,000,000 tools suitable for use by men having an artificial arm, to enable them to carry on their previous trades as plumbers, blacksmiths, carpenters, etc., could be sold. One expert claims that there is at present a market for at least 100,000 small motor cars or electric tricycles, well and simply constructed and easily manipulated, for the use of crippled officers and men. No such machine has yet made its appearance in the open market; and when a practical motor car or tricycle appears at a price below $500 the sale of a large number seems assured from the start. An efficient hill-climbing electric tricycle or motor,—one easily understood and handled by an armless or legless man—would meet an urgent need, and if such a machine were ready at the close of the war, the sales reached would be beyond any figures yet reported.

Blast Furnace Slag for Road Construction.—For a number of years blast-furnace slag has been used in the country districts and manufacturing towns of England for the construction of roads and as a macadamizing agent. If properly selected, it forms a very good foundation, but should be placed at an incline in such a manner as to hold each lump upon its adjacent lumps, to prevent rocking, and then should be covered over with fine blast slag and properly rolled and consolidated afterwards. It is also successfully used with tar and other bituminous materials for footway and sidewalk paving. As a concrete aggregate it is a very good material, if clean, but it takes almost double the quantity of cement required than when working with river gravel as an aggregate. Owing to its very absorbent nature it requires much greater care in mixing, and for this reason some engineers will not use it if other aggregates are available, nor is it considered economical to use it unless it can be found at or near the spot and can be delivered at the mixing floors or machines at very low charges for transportation. It is principally used in this connection for floors of warehouses. When once set, concrete made from blast-furnace slag is very tenacious and it is almost impossible to break it up with pick or bar.

Science

A Department of Coal-Tar Color Chemistry has now been in operation for two years at the Huddersfield Technical College, England, and provides specialized chemical teaching, with research facilities, for the many chemists engaged in the vast color industry which has recently grown up at Huddersfield. Dr. H. H. Hodgson, formerly head of the chemical department of the Northern Polytechnic Institute in London, and later chief chemist for a large manufacturing firm, has just been appointed head of the department at Huddersfield.

The Nation's Work in Terms of Man-power.—In the latest of the interesting series of pamphlets on "The Mineral Industries of the United States" issued by the U. S. National Museum, Messrs. C. G. Gilbert and J. E. Pogue point out that modern civilization is founded upon the work of machinery, as ancient civilization was upon that of slaves. The power utilization of the United States is estimated at 150,000,000 horse-power, and one horse-power is assumed to be equivalent to 20 man-power. On this basis, the work annually done in the United States, or at least the equivalent in such kind as men could perform, would require the labor of 3,000,000,000 hard-working slaves, and the use of power gives to each man, woman and child in this country service equivalent to that of 30 servants.

Hereditary Hay Fever.—Dr. W. Scheppegrell, president of the American Hay Fever Prevention Association, has recently made an analysis of 415 cases treated in the hay fever clinic of the Charity Hospital at New Orleans and elsewhere in that city in order to determine the influence of heredity on this disease. He finds that in more than one-third of the cases the patients had a father, mother, brother or sister who was a victim of the disease. Probably the influence of heredity is even greater than indicated by these figures, as specific susceptibility may exist indefinitely without developing hay fever, by reason of insufficient exposure to the pollens that cause the malady. The question of the development of a natural immunity from continued exposure to the specific pollens is, says Dr. Scheppegrell, a difficult one to settle, on account of the difficulty of eliminating the question of decreased exposure.

Seaweed as a Source of Alcohol.—Experiments made at the Pasteur Institute, in Paris, by M. Kayser, indicate that the seaweed *Laminaria digitata* is a promising source of alcohol. The plants, previously washed to extract the mineral salts or unwashed, were reduced by evaporation to 10 per cent. They were then treated with water containing from three to six per cent of sulfuric acid for half an hour or an hour, at 122 degrees C. The sugary liquid was neutralized to one per cent of acidity, nitrogenous material added in some cases, and was sprinkled with brewers' yeast. Fermentation was readily induced, especially in the flasks containing nitrogenous material, and an average of six liters of alcohol per 100 pounds of dry seaweed was obtained. The investigator believes that with higher pressures larger quantities could be obtained, and that the residue could be used for the extraction of mineral matter and potash as by-products.

Tubercle Bacilli in Cheese.—Messrs. E. C. Schroeder and G. W. Brett have recently reported the results of an examination of 256 samples of cheese for the purpose of determining the frequency with which this product is contaminated with virulent tubercle bacilli at the time it reaches the consumer. The general conclusions of these studies are that cheese of the kind that requires some time to ripen rarely if ever contains true, living pathogenic bacteria when it is marketed, while cream cheese is often heavily contaminated with tubercle bacilli of the bovine type. Hence cream cheese should be made either from pasteurized milk and cream or from milk and cream obtained from cows which have been proved free from tuberculosis. Cottage and skim milk Neufchatel cheeses are much less frequently infected with tubercle bacilli than cream cheese, but contamination is frequent enough to indicate that they should not be made of raw milk.

The Wasted Resources of Coal.—In these days of economizing, nothing is more striking than the fact that, although about a thousand products obtainable from bituminous coal are in current use and an almost unlimited number of others await discovery by chemists, we consume in this country every year in its raw state, and for the production of energy only, about half a billion tons of coal. The fact that a great deal of coal is wasted through imperfect methods of mining and conversion into energy has often been pointed out, but less attention has been given to the enormous waste of potential coal products. According to a recent estimate by Messrs. Gilbert and Pogue, of the U. S. National Museum, the loss under the latter head amounts to about a billion dollars a year. A practicable first step toward conservation, these writers believe, lies in the direction of enlarged municipal gas plants, which will handle all the coal needed by the community, with the production of solid fuel, gas, and the by-products ammonia, benzol and tar.

Automobile

Heavier Fuels.—No matter how long, or how short, a time the war continues there is little prospect that the price of gasoline will ever return to the level at which it stood even two years ago, for war necessities have hastened the development of motor transportation so greatly that the demand for fuel will continue to bear heavily on the supply. Heavier fuels must therefore be resorted to, and methods for utilizing such fuels, for all ordinary forms of motors, are as yet far from satisfactory. Heretofore the engine maker has continued largely inactive, relying on the carbureter designer to produce the necessary apparatus; but in the end, it will probably be found that the burning of heavy oils in the type of engines now used in motor cars is a matter of engine design, and that the heavy fuel must be mechanically atomized, and not vaporized, as so many are attempting. Even gasoline is fast approaching a condition where the same method of handling will have to be adopted.

Air Cleaners.—Although it has been well known for years that the grit drawn into an engine through the carburetor, with the air required for the combustion of the fuel, is largely responsible for the wear of cylinders and pistons no serious attention has been given to the subject until quite recently, when the Government specified an efficient air cleaner on its war trucks—although such a device hardly existed. This action has had a very salutary effect in a much needed direction. The interest in farm tractors has also had a great deal to do with stimulating the invention of a satisfactory air cleaner, for it was found that the great amount of dust stirred up by a farm tractor in its ordinary work had such a serious effect on the operation of the motor that action by the makers was necessary. Now the problem is being taken up actively, and we may expect that all future farm tractors will be properly equipped, and the device will probably constitute a strong "talking point" in the sale of trucks. Whether it will appear soon on the general (*ne* pleasure) automobile will depend largely on whether buyers insist on it. It certainly would be more desirable than some of the showy accessories now used to attract the attention of the public.

Road Building.—Our improved roads and their builders usually have one feature in common; they are smooth and attractive on the surface, but no one knows what is underneath. With motor traffic rapidly increasing in volume and weight the necessity for substantial foundations becomes more and more apparent. Most of our existing roads were not designed with a view of carrying the heavy loads now imposed upon them, and in new roads it would seem the builders cannot realize the present changed conditions and the new character of the traffic; in any case the problem is not an easy one. Every element of a modern road requires careful design and the best of workmanship. The foundation especially must be deep and substantial, and for this it would seem that the usual layer of crushed stone is entirely inadequate and unsuited. Underdraining is also very important, but usually is laid out on theory rather than a consideration of actual conditions that vary every few yards. The surface is vitally important, for it should be absolutely smooth, as any initial irregularity forms a starting point for disintegration under the trip-hammer blows of a heavy truck wheel. It costs money to build a good road, but we have got to have them, as the experience of the past, and the coming winter will demonstrate.

Decarbonizing Cylinders.—Considerable interest has been aroused by a recent note in this column in regard to the use of salt for removing the carbon from cylinders of internal combustion motors, and letters received suggest further comment. The material employed is fine table salt, and it is evident that its action is not of a mechanical nature as this salt is not hard enough to work in that way. For the same reason there can be no danger of the salt doing injury to the cylinder or piston. It is therefore apparent that the action is of a chemical nature, but what the reactions are is difficult to surmise, as they must in the nature of things be of an extremely complicated character, and a protracted investigation would be necessary to determine exactly what they are. It has been suggested that some hydrochloric acid may be evolved, and that this might act on the metal of the cylinder and piston, causing injury. This, however, does not appear to be a serious objection, as the amount of acid could not be very great, and, moreover, all of the products of the reactions that occur are expelled from the cylinder within such a brief period of time that any possible action upon the metal of the cylinder should practically be trifling. Of course it is not advocated that any de-carbonization process should be employed frequently; and even scraping may result in damage to the cylinder if not carefully done. If an engine requires cleaning more than twice a year there is something wrong with the carbureter, the oiling system or the way the engine is operated, and the owner should have adjustments made, and get expert advice on the proper way to handle his throttle.

Farms for Returned Soldiers

A Quarter of a Billion Acres of Unused Land

By Hon. Franklin K. Lane, Secretary of the Interior

Turning the first sod on a homestead at Sun River, Mont.

THE historian who in the years to come writes the economic history of the United States will unquestionably find a mile stone in the Sundry Civil Act for the fiscal year ending June 30th, 1919, and especially that portion which provides for an appropriation of $100,000 "for an investigation to be made by the Director of the Reclamation Service of the reclamation by drainage of lands outside existing reclamation projects and of the reclamation and preparation for cultivation of cut-over timber lands in any of the States of the United States," and an additional $100,000 for an investigation of new irrigation projects.

These sums, small as they are, mark the beginning of a vast scheme of reclamation of our unused lands, which, if carried to its ultimate and logical conclusion, will mean the addition of some 200,000,000 to 250,000,000 acres to the real territory of the country, provide work for hundreds of thousands of American citizens, and afford an opportunity for additional hundreds of thousands to acquire homes.

Up to the present time there has been no general plan for the reclamation of this great area of unproductive land. It is true that a comparatively small beginning has been made by the Reclamation Service in the construction of irrigation projects in the arid West, but the total area of irrigable land comprised in these projects under the works now constructed or contemplated, approximates only 3,000,000 acres, or only a little over one per cent of the total unused and unproductive arid swamp, and cut-over timber land of the country as a whole, which may ultimately be brought under the plow.

What the Reclamation Service Has Done

In order that the reader may get a passing glimpse at least of the value of reclamation, it may be interesting to present a few statistics regarding the results accomplished by the Reclamation Service since its organization on June 17th, 1902. Up to the end of the fiscal year ending June 30th, 1918, the Service had invested over $100,000,000 in some thirty projects in the so-called arid and semi-arid States of the West. Scores of huge storage and diversion dams have been constructed to hold the meager water supply of these regions and divert it when needed through thousands of miles of canals and laterals to the waiting land. The total area to which the Reclamation Service was prepared to supply water during 1917 amounted to 1,600,000 acres, of which the area actually irrigated totaled 1,060,000 acres. The value of the crops grown on the Reclamation projects for the season of 1917 amounted to nearly $60,000,000, without including livestock industries, dairy products, wool, etc. When the projects are completed the area under cultivation will approximate 3,000,000 acres, supporting a population of 250,000 people on 60,000 farm homes.

Although no complete survey has ever been made of our land resources, it is estimated that there are from 15,000,000 to 20,000,000 additional acres of at present arid land in the West for which water is available if properly conserved. There are, for example, half a million of acres in the Colorado River Basin, which need only irrigation to make them as fertile as the far-famed valley of the Nile.

By far the greater portion of our unused and unproductive lands, however, is comprised in the cut-over of logged off timber land lying largely within the eastern half of the United States. The approximate area of these cut-over lands, by States, is shown in the following table, which has been compiled from various sources of information, such as township, county, and state officials, lumber and logging companies, and individuals well-informed on this subject in their particular localities:

State	Acres	State	Acres
Alabama	14,785,000	New Jersey	1,151,000
Arkansas	13,893,000	New York	5,997,000
California	3,031,000	North Carolina	12,745,000
Florida	10,109,000	Oregon	3,537,000
Georgia	20,141,000	Pennsylvania	5,297,000
Idaho	676,000	South Carolina	8,994,000
Kentucky	3,222,000	Tennessee	7,833,000
Louisiana	11,877,000	Texas	12,936,000
Maine	6,135,000	Vermont	2,070,000
Maryland	1,848,000	Virginia	9,929,000
Michigan	11 686,000	Washington	3,330,000
Minnesota	14,022,000	West Virginia	4,634,000
Mississippi	13,203,000	Wisconsin	13,246,000
Missouri	8,900,000		
Montana	674,000	Total	228,509,000
New hampshire	2.608,000		

In their present state these 228,509,000 acres of cut-over land are a picture of desolation calculated to discourage the hardiest pioneer. Only a vast area of stumps remains to mark the former forest, matted with underbrush and interspersed here and there with saplings. Perhaps as good an idea as any of the appearance of this waste land may be obtained from photographs of former forests which have been shattered by artillery fire. Yet when this land is cleared, leveled, and brought under the plow its soil, rich with the accumulated humus of hundreds of years, possesses extraordinary agricultural possibilities.

Lying also largely in the eastern half of the United States and overlapping the cut-over lands to some extent are some 80,000,000 acres of swamp land. The approximate extent of these lands, by States, is shown in the table in the next column.

Where private enterprise has reclaimed small areas of swamp land, the wonderful productivity of the soil has been amply demonstrated.

Private Enterprise Inadequate

Under present conditions the problem of reclaiming these vast areas of irrigable, cut-over, and swamp land could never be solved in its entirety by private enterprise. The huge items of labor and capital involved dwarf into insignificance any work of a similar character ever before undertaken. The great public works of the Reclamation Service and of the Panama Canal for example, stimulating as they are to our national pride in achievement, fall far short of the possibilities involved in the plan of reclaiming an area one-fifth again as large as the State of Texas.

Classified Acreage of Unreclaimed Swamp and Overflowed Land

State	Permanent Swamp	Wet Grazing Land	Periodically overflowed	Periodically Swamp	Total
Alabama	900,000	59,200	520,000		1,479,200
Arkansas	5,200,000	50,000	531,000	131,300	5,912,300
California	1,000,000	1,000,000	1,420,000		3,420,000
Connecticut		10,000	20,000		30,000
Delaware	50,000	50,000	27,000	200	127,200
Florida	18,000,000		1,000,000	800,000	19,800,000
Georgia	1,000,000		1,000,000	700,000	2,700,000
Illinois	25,000	500,000	400,000		925,000
Indiana	15,000	100,000	500,000	10,000	625,000
Iowa	300,000	200,000	350,000	80,500	930,500
Kansas		59,380	300,000		359,380
Kentucky		100,000	300,000	44,600	444,600
Louisiana	9,000,000	1,196,605			10,196,605
Maryland	100,000		92,000		192,000
Maine	156,520				156,520
Massachusetts	20,000		30,500		50,500
Michigan	2,000,000	947,439			2,947,439
Minnesota	3,048,000	2,000,000		784,308	5,832,308
Mississippi	3,000,000		2,760,200		5,760,200
Missouri	1,000,000		1,439,700		2,439,600
Nebraska		100,000	412,100		512,100
New Hampshire	5,000		7,700		12,700
New Jersey	326,400				326,400
New York	100,000	100,000	329,100		529,100
North Carolina	1,000,000	500,000	500,000	748,160	2,748,160
North Dakota	50,000	50,000	50,000	50,000	200,000
Ohio			100,000	55,047	155,047
Oklahoma			31,500		31,500
Oregon	254,000				254,000
Pennsylvania			50,000		50,000
Rhode Island			6,000	2,064	8,064
South Carolina	1,500,000		622,120	1,000,000	3,122,120
South Dakota	100,000		511,480		611,480
Tennessee	639,600				639,600
Texas	1,240,000	1,000,000			2,240,000
Vermont	15,000		8,000		23,000
Virginia	600,000		200,000		800,000
Washington	20,500				20,500
West Virginia			23,900		23,900
Wisconsin	2,000,000			360,000	2,360,000
Total	52,665,020	6,826,019	14,747,805	4,766,179	79,005,0 3

But, fortunately we are not limited to private enterprise in bringing about the greatest scheme of reclamation the world has seen. The Federal Government or the Federal Government in coöperation with the States, can undertake the work in its entirety, unhampered by questions of financing or returns on investment within a limited time, but with a single view to the ultimate economic welfare of the country as a whole. Given the funds, the Reclamation Service of the Department of the Interior, already organized and tried in the fire of experience, can be expanded to any limit authorized to bring about the desired result.

Millions of Men Needed

One great problem to be met in the construction of these works is that of labor. Millions of men will be needed. It is at this point that these unproductive lands and the returned soldier are brought together. When the war

From left to right, Messrs. Davis, Cory, Mead and Hanna, of the Reclamation Service

The crop performance, after reclamation, of Montana desert land like that shown above

is over our ports will be thronged with millions of fighting men who will be clamoring for an opportunity to earn a living. With the shutting down of war industries the return to normal conditions will be difficult enough, leaving out of consideration entirely the amalgamation of these fighting men into our body politic.

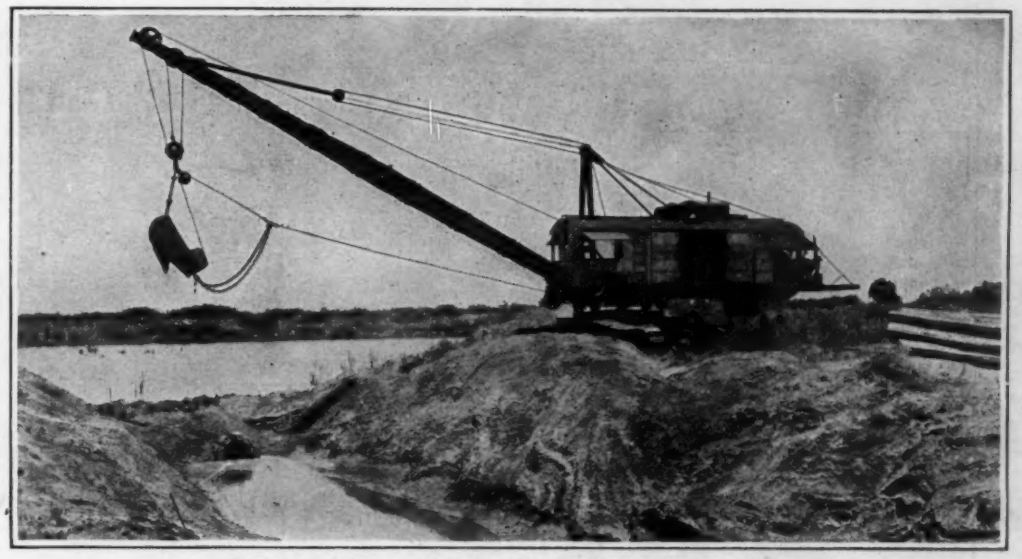
Assuming that there is no attempt at industrial guidance on the part of the Government or other organized agency, the labor situation will present to these returned fighting men about four possibilities. Undoubtedly many will return to the same positions which they held before joining the colors. Others will find jobs in trades which they have learned during their period of service. Others will take the first job offered, whether they are particularly fitted for it or not. The remainder will fall into the class of the drifters, taking a job here and there, seeking work and frequently not finding it, and fast becoming an economic liability of the Nation.

With intelligent direction, this situation can unquestionably be changed, not only to the advantage of the men themselves but to the country as a whole. The great public works involved in the reclamation of our unused lands will provide an opportunity for all classes of labor from the highest technical positions to the man who can handle a pick and shovel.

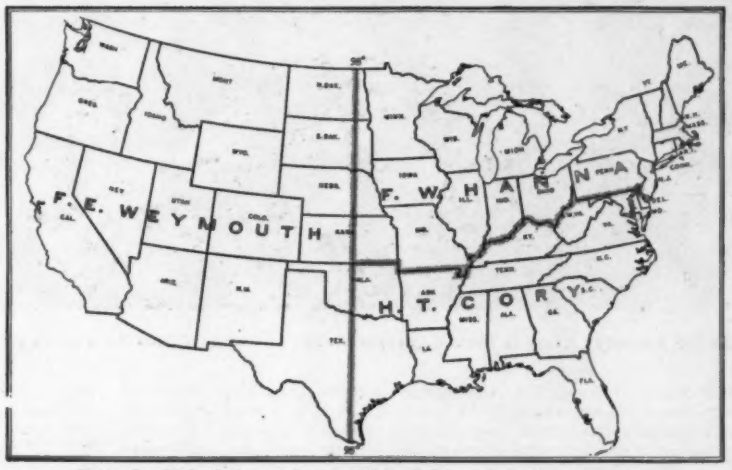
Unused Lands in Every State

The plan then affords an opportunity for every returned fighting man to secure work, if he wants it. And it doesn't mean that he will have to go far from his home State to find work. Practically every State in the Union contains large areas of irrigable, cut-over, or swamp land or other unused lands that will be a part of the great scheme of reclamation. The man from the Western States will find an opportunity to work on the construction of an irrigation project; the man from the eastern half of the United States will be placed on work

(*Continued on page 382*)



Draining a lake caused by seepage in the Rio Grande district



How the United States is apportioned for reclamation purposes

Some Biological Features of Roots

By Dr. W. A. Cannon, Desert Laboratory, Tucson, Ariz.

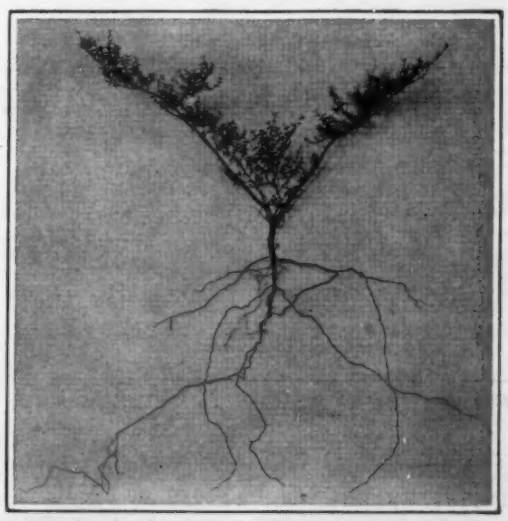
ROOT environment is a very complex subject. It includes biological and physical features in great variety. Without going at all into the former, it is plain that among the latter are included the soil—its composition, its temperature, its aeration and its water supply. For present purposes the soil may be conceived as composed of particles of different sizes, which are surrounded by a thin film of water and between which is the soil atmosphere. Of the soil factors enumerated, temperature and aeration are perhaps the most important. Both of these are affected by the size of the soil grains and by the water content. Generally speaking, soils with the smallest particles puddle most readily and hence are the most poorly aerated.

A plant should be thought of as saturated with water in every living part, so that there is a direct and unbroken connection between the soil water and that inside the body of the plant, both in the root and in the shoot. The plant obtains its water through the root system only, and, in addition to the water, and contained therein, are various salts, as well as oxygen derived from the soil atmosphere.

Since, in certain known cases and possibly in all, a certain amount of oxygen is necessary for the roots in order that they may absorb water, the necessity of adequate soil aeration to the well-being of the plant is apparent.

The rate of growth is directly influenced by the temperature of the soil. The rate is relatively rapid when the temperature is high, and *per contra* becomes comparatively slow at low soil temperatures. So important is the temperature of the soil to the plant that, given a soil with favorable moisture and air content, under favorable temperature, the species will survive, irrespective of the temperature to which the shoot may be subjected—provided, of course, this be not one plainly inimical to growth.

Just as the shoots of plants are different as between different species, just as the shoot development of individuals of the same species may show wide divergence, so different species and different individuals of the same species may have different root development. But as in the case of shoots, within certain limits the root systems of plants also owe their leading characteristics to direct response to the impinging environment. This can be best illustrated by citing examples with which the writer is familiar, namely, certain plants growing in the arid regions of the Southwest.



How the roots and shoots of a plant are scaled off

Normally the cactus has a single anchor-root, with the balance of the root structure within three inches of the surface

Under experimental conditions the cactus roots behaved like this

It is now well known that the roots of the cacti lie near the surface of the ground. What are the possible leading causes for this? Carefully conducted experiments show that, in order to induce an active rate of growth, the soil must be kept at a relatively high temperature. But such favorable soil temperatures occur near the surface of the ground only; hence the most active growth of the roots of the cacti takes place in the uppermost soil layers so that the root system develops as a superficial one. There appears also to enter another condition leading to the same result; the cacti as distinguished from most non-succulents demand that the roots be well aerated.

The probability that temperature and aeration are largely if not wholly the dominant factors in the root position of the cactus is shown directly by experiments in which the roots of opuntia were induced to penetrate the ground to a depth of about three feet. In these experiments, either the soil was maintained at a favorable temperature to a relatively great depth, or on the other hand it was a made soil in which so much coarse material was added that deep aeration was also possible. How great was the alteration in the usual course of root development will appear when it is stated that under ordinary conditions the roots of the species are for the most part less than three inches deep, and that often they lie just under the surface of the ground. In fact, there are usually two well-marked parts to the root system, a single tuft which anchors the plant and which may occasionally enter the ground as deeply as 18 inches, and the widely extending, shallow system which reaches out, as described, from the base of the shoot.

The root habits of a second species, the mesquite, may also be referred to. This is one of the most familiar trees of the arid Southwest. A species having a root system more unlike that of opuntia would be difficult to find. The roots of the mesquite may penetrate the ground as deeply as fifteen to thirty feet, and on the other hand roots have been reported so close to the surface that they could be dug out with a cane, and in at least one instance such a superficial root was traced for 70 feet from the base of the shoot. As might be expected where the habit is so varied, the roots of the mesquite exhibit a very wide range in their reaction to such soil environmental factors as were spoken of above. They appear able to do with a smaller amount of air than has been found the case with opuntia, they are more resistant to carbon dioxide, and they show a greater range of temperature reaction, especially in that they have a fairly active rate of growth at low temperatures.

It is customary, for reasons not difficult to appreciate, to base the distribution of plants upon such factors as atmospheric temperature and humidity, rainfall, etc., to the total disregard of the possible influence of the root reactions upon the phenomenon. With increasing knowledge of the reactions of roots this is likely to be changed. To illustrate how relatively independent the root may be of the aerial environment, a single illustration may be given. As has been already mentioned, roots of opuntia require a fairly high soil temperature in order to grow at a reasonably rapid rate. If a species of this genus be removed to a cool equable climate, no growth will take place, either of root or of shoot. If, however, the root be kept suitably warm, while the shoots are left at the normal low air temperatures, not only will growth be active, but the shoots will grow as well as the roots.

The cacti occur native in warm regions where rains occur in the warm season. Thus the family attains its greatest development in Mexico, where the rainfall is in the summer. In fact, we note that in all cases where cacti thrive the soil conditions are favorable for active root growth during the warmer season. The soil is not merely warm, it is moist at the same time. Had the cacti another type of root reaction to the soil air and the soil temperature, deep penetration would be possible, and without question a very different distribution of the family would follow than is actually the case.

Strategic Moves of the War, October 30th, 1918

By Our Military Expert

With the American Army in France—preparations to meet an approaching gas wave

IT is evident from the military maneuvers and successes of the Entente Allies at the present time that we have entered fully upon the "glorious days" so strongly dwelt upon by Marshal Foch in a recent communication. The armies in Belgium have cleared the Belgian coast, have brought the lines of the Allies to the frontier of Holland and have practically wiped out the barrier of the Scheldt in their moves upon Ghent, Antwerp, Brussels and other Belgian towns further south. Valenciennes, the norther terminus of the great strategic railway paralleling the German lines through Avesnes, Hirson and Mézières to Metz, has been practically taken and each day brings added news of villages released, woods cleared and streams crossed in the Allied advance on this part of the front.

The Germans had been holding the line of the Scheldt in reserve to cover Valenciennes, Tournai and Ghent; but it held scarcely a day before its main strength disappeared under strong Allied blows. The Scheldt was reached by the Germans too late to reorganize their shattered forces and to make a stand. On October 21st the British troops were on the west bank of the river opposite Audenarde and at Tournai, and on the following day Valenciennes was taken in part. Not only is the town a most valuable railroad center, but it is also the hinge of the entire Scheldt-Avesnes-Hirson line to the Meuse. At this town the German line turns southeast to cover the strategic railway connecting the German armies in Belgium with those in the Guise-Serre-Oise salient and the positions north of the Serre River. When the Lille-Menin-Roulers line was broken recently, the Germans lost all western Belgium as well as all the northeastern part of France held by them. By taking Valenciennes, the great industrial centers of Lens, Cambrai, Lille, Roubaix, Tourcoing and Valenciennes itself have been freed, to begin again the reëstablishment and reconstruction of French industrial efforts here. No French town of any great size is now held by the Germans.

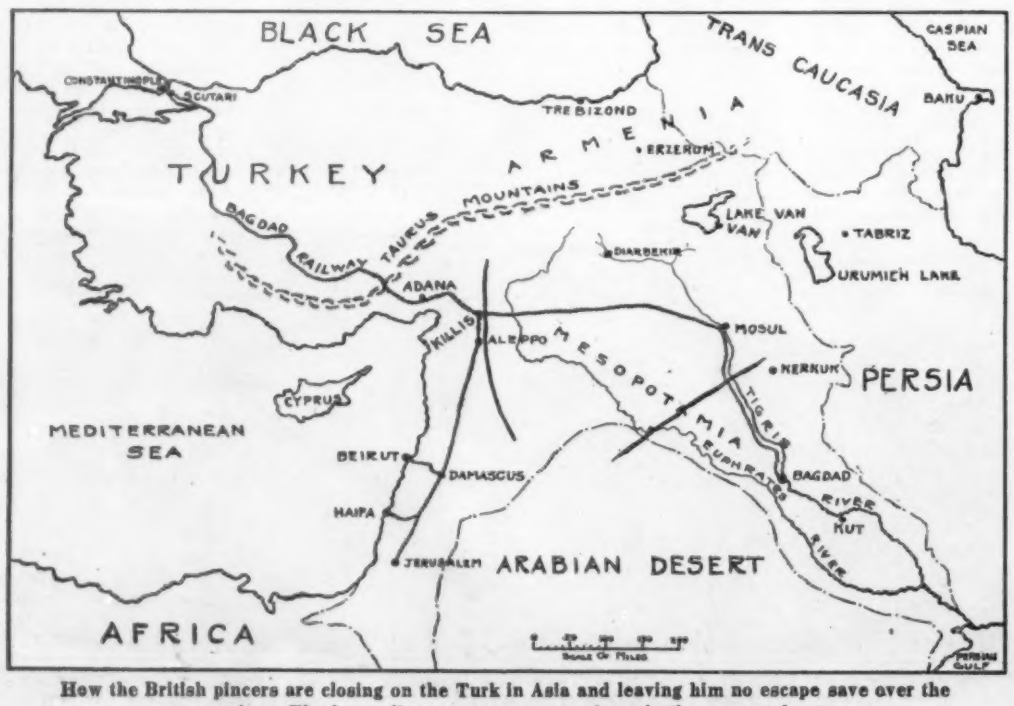
It is absolutely essential, as their positions now stand, that the Germans must withdraw to a line covering Antwerp, Brussels, Mons, and Maubeuge; the new line would then run southeast to Hirson joining up with the lines in the Champagne and north of the Argonne woods depending upon the points there to which the Germans will ultimately retreat. The German withdrawal in the north, pivoting on Mons-Maubeuge-Hirson, will probably be much more rapid than in the Champagne, because in the Oise-Serre salient and in the Champagne it will be more difficult to retreat from their present exposed positions. To drive a wedge into what is probably the most vital position of the lines that the Germans are holding on the northern portion of the western front, the British made recently an attack of a desperate nature on the strong German positions south of Valenciennes. A salient here would menace the German lines all the way to Holland and, if it can be widened, it would also greatly affect the enemy's front on the south. By what has already been done in the vicinity of Valenciennes, the Scheldt River line has been outflanked and turned here at its southern end. By the strong attacks now being directed against Ghent and Tournai, both on the river, the line will soon be broken at these places. Further south the British are gaining towards LeQuesnoy which is only nine miles from the strategic railway heretofore mentioned so often. While this railroad has been cut below Valenciennes, it will soon be severed at several places to the south and will be practically out of commission as far as Hirson.

Almost all the fighting has been carried out in the past two weeks on the northern part of the front, although the "nibbling" process on the German positions is constantly kept up in the salient near Guise on the Oise, on the Serre River, and in the region both east and west of the Argonne forest. Until recently there were no attacks on a large scale; but the constant fear of such attacks in force has no doubt kept German reserves here ready for immediate use. North of Verdun the American troops have had some desperate struggles, making relatively slow progress due not only to German resistance but also to the very difficult nature of the terrain over which the movements are taking place. The Germans are doing their best to hold the gap at Stenay on the Meuse for it is the only way out for a large part of their armies to withdraw to the east of the Ardennes and practically the same for the retreat of any great number toward Sédan, Mézières and to the west of the same mountains. The French are just about ready now to close in on the Guise salient from the northwest and are striking also from the south; they have crossed the Serre River, thus finally breaking the line here. The success on both sides of the salient will undoubtedly soon cause a German retreat from the Serre in the direction of Vervins, because this is the last water line controlled by them between the present front and the Meuse.

The natural converging point for the Germans here will be at Hirson on the strategic railway at the Belgian border. At the present writing heavy fighitng is in progress all the way from Valenciennes to the Meuse River. Despite a most desperate resistance on the part of the Germans, the Allied troops are everywhere making substantial headway in driving the enemy back of the Meuse line. Although there have been no sensational successes and but little ground gained relatively, the German wastage of men and material has been most serious; it is estimated that in the last few days the total losses in effective material have been at least seventy thousand men and two hundred guns.

In fact, there are four great battles going on now almost continuously: the first is being carried out by the British who are advancing towards Mons and have already reached the Valenciennes-Hirson railroad. The second is the attack by the French north and east of Laon in the Guise-Serre salient; this attack has been on a front of eight or ten miles and has made progress to the front, probably for a distance of five miles in the direction of Hirson. The third battle is being fought by the French on a front of fifteen to eighteen miles from the marshes of Sissonne to Château Porcien on the Aisne, where two systems of German defense lines meet. The fourth battle is the advance of the French and American armies north of the Argonne forest along both banks of the Meuse toward

(Continued on page 382)



How the British pincers are closing on the Turk in Asia and leaving him no escape save over the mountains. The heavy lines represent approximately the present fronts

Development of Vegetable-Drying in Germany

What the Enemy Is Doing to Reduce Wastes and Control Production

THE *Deutsche Tageszeitung* of February 20th, 1918, reported in brief an address which was delivered before the German Agricultural Society shortly before that date by Dr. Eisener, a member of the "Central Office for the Drying Industry," a summary of which follows:

The vegetable-drying industry in Germany has developed tremendously during the war; in fact, it has developed to such an extent that it may be taken to have reached its zenith. Lack of vegetables will prevent further expansion. Attention is called to the fact that the number of factories established for the purpose of drying vegetables for human consumption and for feeding purposes has increased to such proportions that even kitchen refuse is being experimented with in the larger cities. Dr. Eisener predicts that the importance of this industry will greatly diminish after the war, when Germany becomes less dependent upon its own production of vegetables than now, and therefore does not need to be so sparing.

According to a recent census, Germany now possesses over 700 factories for drying specially potatoes, 150 corn-drying establishments, 400 open drying plants suitable for partly desiccating different products, 250 vegetable-desiccating factories, 22 milk-drying establishments, and 400 plants established specially for the drying of cabbages. As an indication of the increase in the use of dried vegetables, statistics regarding the drying of potatoes may be cited from the "Eleventh Supplementary Memorandum on War Economic Measures," which was laid before the Reichstag early this year. This memorandum gives the following figures regarding potatoes dried in Germany during the years mentioned: 1913-14, 11,500,000 hundredweight; 1915-16, 17,500,000 hundredweight; present capacity, 37,000,000 hundredweight. The same memorandum further states that about 200 of Germany's total of 1,500 malt kilns are equipped for vegetable drying.

The industry has likewise become a profitable one in Holland. Vegetable drying was quite unknown here before the war. During the past three years, however, numerous factories have sprung up in all parts of the country. The profit in this industry is largely due to the very strong market in Germany for Dutch dried vegetables. It is reported that the vigor of this market results from requirements in Germany for army consumption. The Dutch industry latterly has been working under serious difficulties on account of lack of fuel. Formerly kerosene was largely used in these factories, but several months ago the stocks of kerosene in Holland became so small that the Government discontinued permitting its use for the purpose of drying vegetables. German coal was then resorted to, low-grade Dutch anthracite being unsuitable and unavailable in sufficient quantities. But supplies of German coal have also failed. At the present time most of the factories of any size are using wood almost exclusively as fuel.

By order of January 23d last the German War Food Minister placed the so-called German Imperial Office for Vegetables and Fruit in supreme charge of all regulations regarding the working-up of vegetables and fruit for commercial purposes. Among other things this regulation provided that the so-called war company for vegetable conserves and the war company for dried vegetables would have exclusive authority to grant permission to use vegetables respectively for conserving and drying purposes. According to this same regulation, manufacturers of these products should be required on demand of the above-mentioned companies or on demand of the Imperial Office for Vegetables and Fruit, to furnish all information regarding their purchases, sales, etc. It would appear as if the way was being prepared for a stricter control of the preserving and drying industry whenever such a step might become necessary.

One of the chief functions of the Imperial Office for Vegetables and Fruit has been the keeping of records of activities of different drying establishments. As a result of these records, idle or partially idle factories have been supplied with vegetables from districts where the factories were being overworked.

Various of the German States have been establishing special commissions, etc., for the purpose of studying and promoting the drying of vegetables.

Along with its work of promoting the economic use of vegetables the German Imperial Office for Vegetables and Fruit has been carrying on an active campaign to popularize the use of dried vegetables. Comprehensive practical cooking experiments have been carried on, and on the basis of these experiments pamphlets containing recipes for the household use of various vegetables, have been issued in large numbers and distributed widely. At present the Imperial Office is said to be conducting careful experiments as to the best method for drying vegetables so as to preserve as much as possible the original flavor. Dried vegetables are not used to any extent in Holland.

An owner of a large vegetable-drying factory in Holland recently stated that the drying processes now used in Holland reduce the weight of root vegetables, including potatoes, by about eighty or eighty-five per cent, and reduce the weight of such vegetables as celery, cabbage, lettuce, etc., by as much as ninety or ninety-three per cent. The fact that the weight is so greatly reduced, coupled with the fact that the volume is not reduced in an equal ratio, makes it possible to pack dried vegetables in containers of very light material. Indeed, practically all of the dried vegetables sent from Holland to Germany are packed in large paper bags.

Spent Bullets Poison Aquatic Birds

A SERIOUS mortality among wild ducks and other aquatic birds has been recently observed in certain regions of this country. At a recent session of the Biologic Society of Washington, Mr. A. Wetmore made a report of his investigations of the subject. He finds that the birds attacked by the malady observed are in reality suffering from lead poisoning due to their swallowing the spent bird shot which abound in the marshes and shallow ponds which form the happy hunting ground of the duck hunter. The birds doubtless mistake these pellets of lead for the gravel and tiny pebbles which it is their habit to swallow as a necessary aid to digestion. Since lead is softer than stone the attrition between the pebbles and the pellets in the gizzard of the misguided bird causes minute particles of lead to pass constantly into the fowl's intestine, where they are partially absorbed. The effect of the poisoning thus produced is a violent diarrhoea, the faeces being characterized by a brilliant green color; the birds later become unable to fly, and subsequently a slow paralysis prevents them even from standing up. An autopsy on ducks suffering from this strange malady revealed that the gizzard contained bullets exhibiting various degrees of wear.

To clinch the proof, Mr. Wetmore reproduced the disease experimentally and found that the swallowing of six bird shot of size No. 6 was always sufficient to cause death; in one case, indeed, a single bullet of this size proved fatal. He also proved that the poisoning was due to the lead and not to the arsenic present or any of its compounds with the lead. The malady appears to be invariably fatal and in some marshy areas large quantities of birds have fallen victim to it.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Martian "Canals"

To the Editor of the SCIENTIFIC AMERICAN:

I wish to offer a suggestion as to the possible meaning of the line-system on the planet Mars in connection with the question of Martian life. Very possibly my suggestion is an old one, though not so to my knowledge.

The contour of the line-system and the physical considerations which arise in connection with the system seem to me to indicate that the geometrical pattern is the feature of significance.

Intelligent Martians—if such ever existed—are probably extinct. Very possibly there were such beings; however, I suggest that possibly a civilization of a high order was once evolved, and that there was constructed a system of "canals" according to a geometrical pattern which was calculated to convey a meaning to the geometrician of earth or elsewhere who should prove equal to the occasion. Such a work could conceivably be done by a civilization somewhat more advanced than our own.

At any rate, Mars offers a challenge to our intelligence. It remains to be seen what the gradual advance of mathematics and physics will do in the matter.

Camp Stuart, Va. S. SUTTON

Anent the "Toothless Saw"

To the Editor of the SCIENTIFIC AMERICAN:

In your issue dated October 5th, page 273, is a letter signed "Sam'l Will John" in which the writer sets the date of the use of the toothless back to 1861 or '62, but I think I can do better than that. In my boyhood I was considerable of a reader and, in the summer of 1859 being in my ninth year I read with great interest an item in the local newspaper in nearly these words:

"A new principle in mechanics has been recently discovered which will no doubt be a great saving of labor. In the test a disk of fine steel, $\frac{1}{16}$ of an inch thick and a foot in diameter, annealed so as to be very soft, was mounted on a shaft like a circular saw and, by means of pulleys and belts, was given a 'rim speed' of five miles per minute. When this speed was reached the hardest files, and also razor-blades, were held to the revolving plate and instantly cut in two, amid a tremendous shower of sparks, without the least injury to the soft disk. A patent has been applied for."

The above item was printed in *The Trempealeau Pioneer* in October, 1859, that paper being the first paper published in Trempealeau County, Wis.

I also read in a book, that year, of steel wheels made to revolve at a high speed and used in making cut glass dishes, etc.

On the whole I think the sacred writer who said, "There is nothing new under the sun," was about right, and Solomon, or even the ancient Egyptians, may have also used the toothless saw. Next!!

Trempealeau, Wis. E. H. CLEVELAND.

Neuralgia and Climate

To the Editor of the SCIENTIFIC AMERICAN:

To sufferers from neuralgia, the following may be of some use.

For the last 34 years I have been subject to neuralgic headaches of great severity, preceding rainfall in the West Indies and Canada, and snowfall in zero weather.

Recently, my recollection of my complete freedom from headaches during my terms of residence on sugar plantations in the West Indies, where the chimneys are fitted with lightning conductors (in comparison with the severe attacks to which I was subject at residences without lightning conductors), induced me to experiment; and, five months ago, I erected a 50-foot pole with a lightning conductor, 120 feet distant from my house.

The result was the departure, within two hours of a seven-day headache; and subsequent exemption, in spite of weather changes. CHAS. H. BOON.

Kamloop, B. C.

Parachute and Plane

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to offer correction on the attached article taken from last week's SCIENTIFIC AMERICAN, entitled "Parachute Jump from Airplane." I believe that your statement therein "the first successful experiment on record of jumping from a moving airplane with a parachute was recently made by Captain Sarrat, a French aviator," is a mistake as this was performed in St. Louis by a Mr. Berry who is the son of Capt. John Berry of St. Louis, the one-time winner of the International Gordon-Bennett Balloon race.

The machine was flown by Aviator Tony Jannus who left Kinloch Park, St. Louis, with a parachute suspended from beneath the fuselage near the landing gear: Mr. Berry was mounted on a small platform near the landing gear and after the machine had ascended to a high altitude and was approximately over Jefferson Barracks in South St. Louis, a distance of approximately twenty-five miles from the start, Berry leaped from the airplane and landed successfully on the Parade Grounds in the Barracks.

This took place in the winter of 1912, and I have actual photographs in my possession showing the airplane with the parachute landing, etc., etc., also the St. Louis daily paper records of same.

This experiment was preceded by numerous experiments which consisted of dropping sandbags from the airplane to determine the effect upon its stability and these preliminary experiments demonstrated that the sudden loss of weight due to dropping large sandbags was entirely unnoticeable to the pilot.

An experiment was tried with a man carrying parachute with 150-pound bag of sand attached and it was found that the parachute failed to open, due to the rush of air which it encountered at the point of leaving the machine.

A large metal cone or funnel was made up and suspended by its small end from beneath the fuselage into which was packed the folded parachute, secured therein by small pieces of cord stretched across the bottom end of the cone. When the drop was made, the weight of the aeronaut jerked the parachute from the cone, breaking the cords mentioned and permitting the parachute to emerge without being effected by the rush of air due to the swiftly moving airplane.

It is my understanding that the designer of the plane applied for patents on the apparatus as used above, though I am unable to verify this.

Keyport, N. J. HUGH ROBINSON.

The intention of the Editor, in the note to which this correspondent refers, was not to assert that Captain Sarrat's leap was the first of its kind ever performed, but the first under military auspices. Unfortunately he omitted this qualifying statement, and so laid himself open to the charge of inaccuracy which this correspondent, and several others, have brought. As a matter of fact, it is quite possible that there were parachute leaps from an airplane before that of Berry—certainly there are many such performances antedating Sarrat's.—THE EDITOR.

Five Dollars—and Worth It

To the Editor of the SCIENTIFIC AMERICAN:

I am enclosing check.....as payment of subscription to the SCIENTIFIC AMERICAN for the year 1919. Notwithstanding the price is to advance to five dollars, I cannot afford to do without the paper; it seems as a part of my family.

I do not recollect the date I first subscribed for the paper, but think it has been coming to me each week for some twenty years. I am a subscriber to quite a number of papers, mostly scientific and engineering, but the SCIENTIFIC AMERICAN would be the last I should surrender. ERNEST C. CRESWELL.

Orono, Maine.

The Men Behind the Guns

Training Officers for Our Heavy Artillery in France

By C. H. Claudy

Heavy artillery drill at the Fort Monroe School

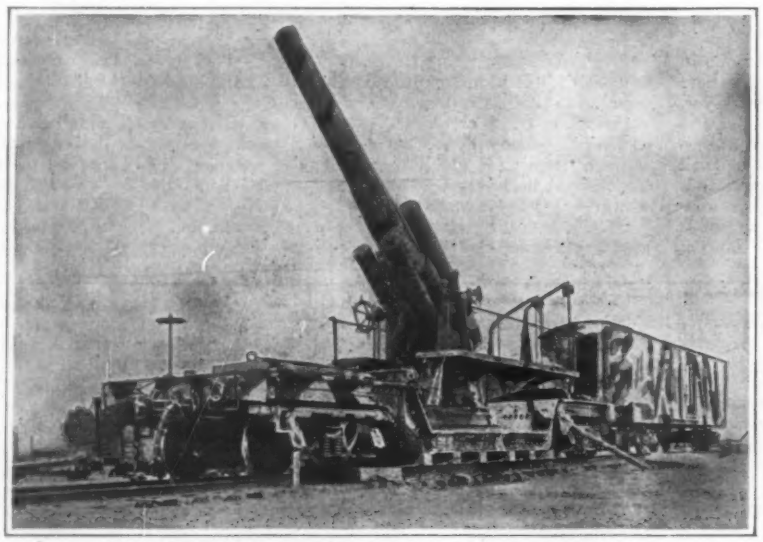
THE title "Coast Artillery" is fixed by law. Prior to the war the Coast Artillery was the only heavy artillery the United States possessed. When it was seen that this was largely an artillery war, when it was seen that the big guns on the Western front were so highly developed an agency for both offense and defense, when official reports began to come back to our General Staff telling of the necessity of our having big guns and officers and men to man them, the job was turned over to the only heavy artillery we had—the Coast Artillery. And every gun over six inches caliber which goes abroad (and there are a lot of them going!) and every officer who commands a heavy battery or any part of it, and every man who serves anything from a six-inch field gun to a 14-inch railroad gun, is a Coast Artilleryman in name, even if he is a Heavy Artilleryman in fact.

Gunnery is not—probably never will be—an exact science. But it uses only the methods of exact science. Method is far ahead of material in heavy gunnery—our mathematics, our surveying, our map-making and reading, our range finding, our ballistics, our knowledge of shot and shell and propellant and gun and carriage and emplacement and concealment, are all superior to the actual gun, shells and propellants we can make. And just because the material is something less than absolutely perfect, it is the more necessary that our methods be the best and that our officers be the most highly efficient, our men super-trained.

It was to train officers in coast artillery work that the Coast Artillery School at Fort Monroe, Va., was established a number of years ago. That school has now been expanded and its courses made to fit the emergency, and it is to that school the United States Army looks, not in vain, for those officers who can handle heavy artillery abroad. It is that school which now needs applications from proper material out of which competent officers for heavy artillery may be made and from that school practically every graduate will go to France sure of actual service at the front.

"Big Gun Corps" officers must have the same qualifications as any other officers in the army—that is, they must be near-perfect physically, intelligent, well-educated, with bright, adaptable, quickly receptive minds, "officer material" as such men are called. Their personalities and their ability to command must be such as will enable them to be good soldiers. But in addition they must possess or acquire a mathematical foundation before they can take the course of training at Ft. Monroe.

For the science of heavy gunnery is largely a science of mathematics. Officers work with maps, with tables, with surveying instruments, with logarithms, with problems which require trigonometry for solution. A man who could make a good colonel of infantry or a successful leader of cavalry, might fail utterly as a second lieutenant of heavy artillery because he lacked the methematical requirements.



Actual conditions are reproduced, even to the camouflage

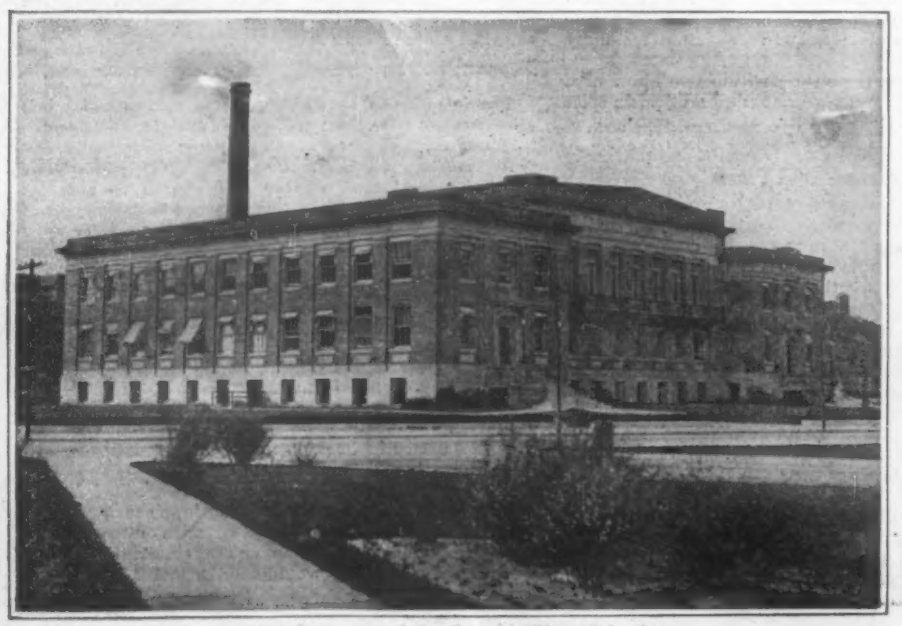
The Coast Artillery School does not suppose that there is enough young "officer material" anxious to become officers of Heavy Artillery, already possessing the necessary mathematics. But it does advise that any applicant think twice before making the attempt if he has not had, sometime in his life, at least a high school training through trigonometry. The ideal material is a college graduate, a civil engineer, a surveyor. But highly satisfactory material has been and is being acquired from almost every walk of life. Lawyers have made most excellent artillery officers, largely, in the judgment of instructors, because their habits of thought are such as easily to lead them to study and assimilation of new knowledge. One of the gunnery instructors at the school at present was formerly a teacher of mathematics, and a successful stock broker who hadn't seen a logarithm in 15 years graduated with honors!

Because comparatively few men are sufficiently "brushed up" in the required mathematics, the Coast Artillery School maintains two preliminary courses for applicants. The man who desires induction into the Coast Artillery with the intention of making himself into an officer can either take a two weeks' course in mathematics at the school before taking his entrance examination, or he can take a six weeks' course. If he feels that he needs neither, he can be examined as to his mathematical knowledge immediately on making his application.

The officers' training course itself lasts three months, and during those three months the candidate for a commission will have to work as he has never worked before. The school cannot and does not stop for the laggard, the lazy, or the mentally incompetent. The candidate's work is laid out for him exactly. He knows every instant of every hour just where he is to be, just what he is to study, just what he is to do. He finds that the instruction is entirely practical—the school is not concerned with teaching him unnecessary theory, but with giving him the practical end of the work. There is not a particle of mathematics—or anything else—taught at the school which is not actually applied in big gun work as that work is performed on the firing line.

Much of the work is field work. The candidate has actual field practice with all the different guns and howitzers, learns to locate a battery in the field and make hits with it, and has courses in orientation, gunnery, gas defense and administration. He has to learn also to be a good soldier as well as a good officer, and so every day he has infantry drill and calisthenics.

The instruction is according to plans made, and is carried out, by officers who have served on the Western



Headquarters of the Coast Artillery School

Instruction in practical surveying

front and who know what is required and what is non-essential. Instructors are continually being sent over seas and returned to the school that it may keep in touch with the very latest methods and the needs of the American Expeditionary Force. Some twenty miles from Ft. Monroe is Camp Eustis, where 20,000 constantly changing men learn to be artillerymen, and here is located a gun range sufficiently large to enable practice to be had up to 20,000 yards. The land (Mulberry Island) has been acquired by the government, all its inhabitants have moved, everything of value has been taken from the houses upon it, and they are now being used for targets.

"What are my chances of getting a commission?" is of course the first question any man asks himself when considering this school.

The answer is "It depends entirely on your ability, your willingness to work and your mental attitude." There is no such thing as a guarantee to accept every applicant for a commission. If the applicant is "officer material" and can convince the school either that he now has the required mathematics or can acquire it in the six weeks, or the two weeks, preliminary course, he is accepted as a candidate. Then he must "make good" himself. There is no question of favoritism or judgment—a man's record is kept from day to day in what he accomplishes and at the end of his course he either gets a commission as a second lieutenant or is turned back to take all or part of the course over, or otherwise disposed of.

But this should be noted and noted carefully. While to take the course a man must enlist in the Coast Artillery, he may do so with the proviso that if at the end of the six weeks' preliminary training in mathemactics he finds himself unable to pass the entrance examination for the training course proper he can revert to his status in civil life, and go from the preliminary course with the thanks of the school for having made the effort and—if it has been an honorable, hard working effort—the cordial good will of instructors who can only regret that he was unable to qualify. This provision is a necessity, because there are many business men, brokers, real estate, insurance, merchant, salesmen, men in all lines, whose knowledge of command of men, ability in business and success as individuals ideally fit them for officer's commission, who nevertheless, either from lack of early mathematical training or a too fixed habit of mind, are unable to grasp the mathematics essential. It would be manifestly unfair to pin such a man to an enlisted man's job simply because he failed to qualify in the preliminary course.

Two hundred men are taken into the school every Saturday. Applicants who are successful in passing the preliminary examination are put in a reservoir company, where from one to ten days or two weeks are spent in military training and some instruction in elementary mathematics.

From the reservoir company the candidate goes to a student company or training company, under the permanent command of a regular officer. These companies are 150 men strong, divided into three platoons or sections each of which has two groups, an arrangement made necessary in order not to have the number of men doing any one thing too great for a single instructor comfortably to handle.

During the course, 68 hours are devoted to Theoretical Gunnery, 24 hours to Seacoast Guns and the same time to Seacoast Mortars, nine hours to Mechanical Maneuvers, 48 hours to drill work and study of the material employed in connection with the Heavy Artillery, of which the use of the telephone and buzzer forms an important part, 57 hours to Orientation and Map Reading, 27 hours to Field Fortification, and 46 hours to Army Administration. These topics are grouped into four major sections of Gunnery, Material, Orientation and Administration; some of the topics fall entirely within a single one of these sections, while some of them are divided between two sections.

The field work is intensely practical. With the great range available on Mulberry Island almost any variety of gun may be used in practice,

Spotting the practice shots from a distance of 3,000 feet

and actual emplacements are made, actual guns oriented and actual target practice held—this, of course, is in addition to the constant work at Ft. Monroe in handling and learning the use the big guns there.

Of course, during the entire period at the school the candidate has the status of an enlisted man and gets an enlisted man's pay and subsistence, clothes, medical attention, etc.

The day's work begins at 6 A. M. (reveille sounds at 5.45) and continues till 11 P. M. when lights must be out and every man in bed. Of this time the candidate has from 9.15 to 10.45 to himself but the rest of the time he is either working or studying or drilling or eating. This schedule does not hold on Saturdays and Sundays, Saturday afternoon and all day Sunday being free time for recreation and amusement. During the working hours the student has every minute laid out for him by schedule, and goes and comes with the precision of the military machine of which he is a part.

The instruction, being of the most intensive character, cannot be, and is not, conducted along the lines laid down in text books. The few text books used have been written expressly for this course, by instructors at the school, and published by the school. Mimeograph papers, worked out at the school, contain the outline of the course and lectures and instructors work very closely to the lines there laid down. For three months is a short period, a very short period, in which to make a man first into a soldier, second, into a good officer, and third, into a competent gunner—and all three he must be if the battery to which he is assigned is to function efficiently.

It is not supposed that any officer at the end of these three months is a finished heavy artilleryman, but the record of our big guns abroad has proved that it doesn't take him long to become one, after he gets on the firing line in France.

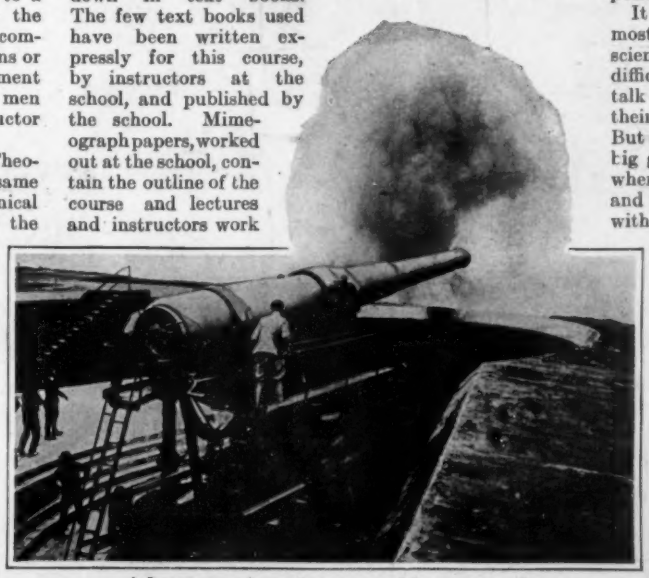
It is perfectly obvious that a battery which doesn't make hits is much worse than no battery at all—for no battery at all at least doesn't cost anything. It costs something like a thousand dollars to fire a 14-inch shell. The life of large guns is limited, and relining is expensive in both time and money. If that relining has been made necessary by shots which have done little or no damage, these few which have done damage represent an enormous expenditure. Manufacturing facilities for material of all kinds are limited and are overworked. Rail and shipping transportation is at a premium—to use them for guns, shells, powder and men that do not function together to the end of making hits is to waste them. The battery which doesn't quickly destroy its objective is apt to be discovered—when it itself may be destroyed. In this war big guns shoot many miles to a target which may be but a few hundred yards in advance of our own men. Lack of accuracy may mean a tragedy. In heavy gun barrage work, say with the six-inch howitzers, the curtain of fire may be required to stay but a few hundred yards in advance of the advancing infantry. If the infantry has no confidence in the accuracy of the gunners, it will not advance confidently, fearlessly—no man relishes being shot by any one, but least of all by his friends who are trying to protect him. From every angle and standpoint, accuracy in artillery work is absolutely essential—and when it is considered that minute factors too small or too well hidden to be corrected prevent any big gun from being entirely and mathematically accurate, it is the more necessary that the men who handle it should get from it the ultimate degree of accuracy of which it is capable.

Hence it is that the school has a very high standard in the course it teaches, and demands hard work, cheerful work, faithful work of its students. But the spirit of the school is entirely that of "come on, let's do it together"—not at all "get it if you can, if you can't, get out." The instructors, many of them graduates, are enthusiastic over the work. The morale is very high. The certainty of foreign service is a great incentive. The men who take the course know that every officer in the school wants them to be successful and wants to help them through. The result is that those who fail, usually fail because they have not the right preliminary training, and these failures are minimized as much as possible by careful and rigid scrutiny into a man's possibilities before he is permitted to take the course.

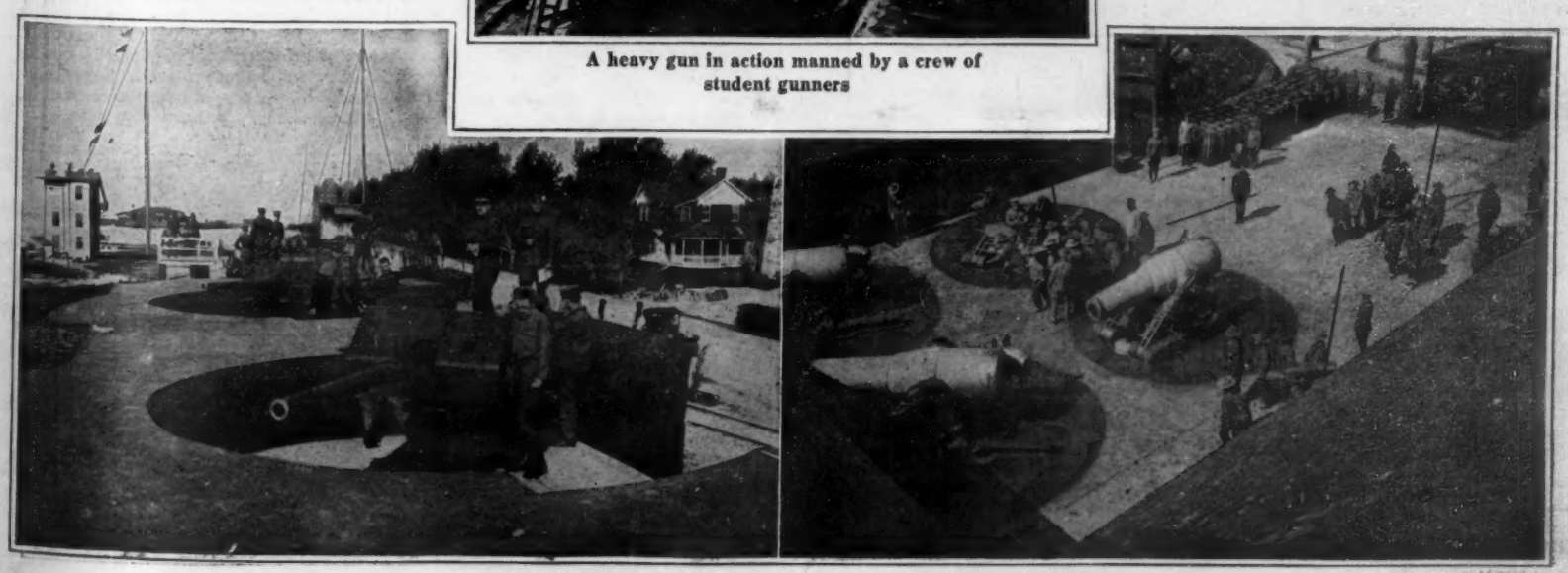
It would be distinctly unfair to what is, perhaps, the most exact, the most intensive, and certainly the most scientific officer school now operating, to magnify the difficulties of the course, or frighten away by too much talk of mathematics those who see in the big guns and their need of officers a chance to get to France and fight. But it would be still more unfair to both school and the big gun corps, to put the school in the light of a place where a man might spend three months of joyful soldiering and receive a commission at the end of it. Any man with intelligence and education, who can get or who has mathematics through trigonometry and who is willing to study and work, should graduate. And the man of affairs, even if he finds it harder to get through the school, will probably run his younger competitor a hard race for promotion.

The school needs men—the right kind of men. It has asked the SCIENTIFIC AMERICAN to tell this story to its readers, in the belief that hundreds will apply, when they know. It offers to any registrant, regardless of his classification, the opportunity to qualify for a fighting man's job.

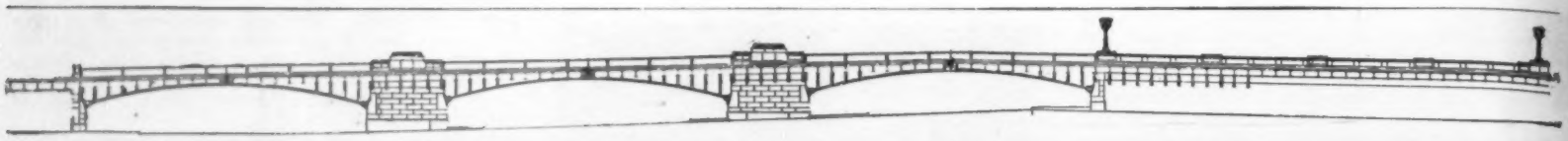
Does this mean you? If it does, address for complete details, Commandant, Coast Artillery School, Ft. Monroe, Va.



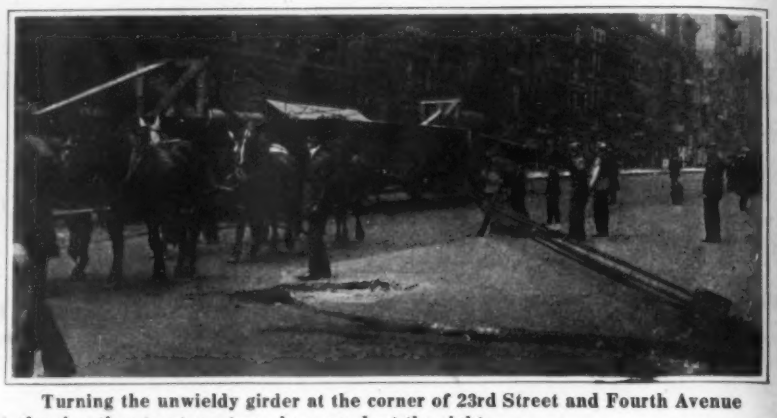
A heavy gun in action manned by a crew of student gunners



Practice with 3-inch rapid-fire guns (left) and sea-coast mortars (right)



A fleet of repair wagons following in the wake of the girder



Turning the unwieldy girder at the corner of 23rd Street and Fourth Avenue

The line drawing above, is a section through the viaduct, showing the street car tunnel approach at the right

The New Approach to the Grand Central Depot

Hauling 75-Ton Girders Through the Streets of New York

THOSE of our readers who are familiar with New York know that the Grand Central Depot is built across Park Avenue at 42d Street. North of the depot the tracks of the New York Central Railroad run under Park Avenue in a tunnel. Park Avenue south of the depot rises over a hill extending to 33d Street and through this hill there is a street railway tunnel. The level of Park Avenue north of the Grand Central Depot is higher than that of 42d Street, and accordingly a driveway has been built around the Grand Central Depot at that level, which corresponds to the second story of the depot. To bridge the valley at 42d Street a viaduct is being constructed connecting this driveway with Park Avenue at 40th Street. Our frontispiece shows this viaduct as it will appear when completed.

According to the agreement between the railroad company and the city, the former has built that section of Park Avenue and the cross streets which pass over the railroad yards, the city bearing part of the expense, while the viaduct south of the Grand Central, was to be built by the city. But owing to the complicated subway work that was being done at this point, the construction of the viaduct was delayed. Now, however, the new subway has been completed and the city is proceeding to carry out its part of the contract. This will furnish a practically uninterrupted avenue with the exception that vehicles will have to make a slight detour on the driveway around the actual depot building.

Another improvement that bears an important relation to this work is being carried out between 33d and 34th Streets. Here there is a ramp on the west side of the avenue by which vehicles can climb from FourthAvenue up to Park Avenue. Now a ramp is being built on the east side as well, thus eliminating the congestion of traffic at this point.

The construction of the viaduct from 40th to 42d Streets has called for the use of some enormous girders which are the largest that have ever been hauled through the streets of New York. The longest of these girders are 135 feet in length, which is considerably more than the length of half a city block. The girders weigh from seventy-two to seventy-five tons each and have a depth of from eleven to thirteen feet, at the middle where they rest on piers located between 42d and 41st Streets. The viaduct will give a roadway 36 feet wide and its entire length is 610 feet.

As may well be imagined, the task of hauling such huge girders through a busy street is no small one. The girders are landed at the foot of 23d Street and the East River. There they are placed on trucks and 52 horses are used to drag each girder up 23d Street to Fourth Avenue and thence up Fourth Avenue to the position it is to occupy in the viaduct. It is interesting to note that it requires 28 drivers to handle the horses, and not a whip is used, the horses being so well trained that they will obey the spoken commands of the drivers

Fifty-two horses hauling the girder up the western ramp of Park Avenue at 33rd Street

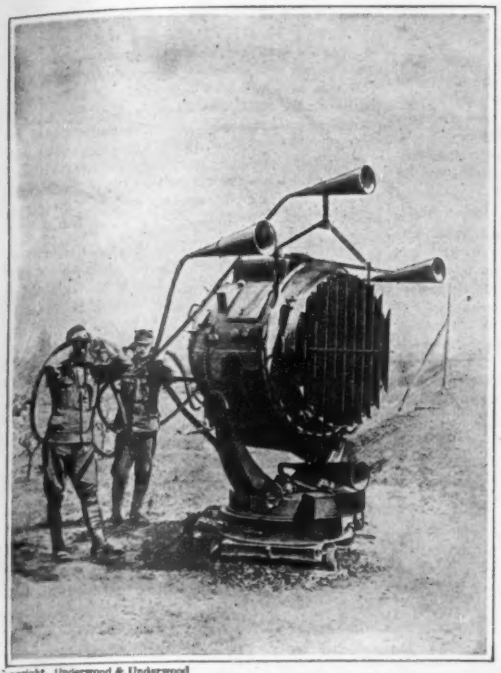
It is impossible to convey so heavy a load through city streets without doing considerable damage. The wheels of the trucks are 15 inches broad so as to harm the paving as little as possible, but whenever they pass over a manhole cover it is quite certain to be smashed. In order to repair the destruction there follows in the wake of each girder, as it is hauled up the streets, a procession of emergency repair wagons. One of our photographs shows this procession. One of the vehicles is the contractor's truck carrying planks, timber and rope and tackle to assist in turning the girder around the corner at 23d Street, which will be explained further on. Another vehicle carries spare harness for the horses who are apt to break whiffletrees and tear leather straps under the tremendous strain of haulage. In addition to these, there is a truck of the Sewer Department, an emergency wagon of the Gas Company, a wagon of the Consolidated Telegraph and Electric Subway Company, whose task is to take care of the manholes of the electric light and power companies, and the Empire City Subway Company, whose particular charge is the manholes of the Telephone Company. In addition to this, there is the New York Railways emergency wagon and the car of the superintendent of the Gas Company.

Of course, every effort is made to protect the manholes as much as possible. Wooden planks, three inches thick, are carried by attendants who place them over the manholes just as the wheels are approaching. These planks have to be laid after the horses have passed over them, or they will be kicked about and displaced. It was for this reason that steel girders were not used, because there is little time in which to place the protection over the manhole and they have to be light enough to be handled by a single man. The planks had to be very carefully chamfered, otherwise the wheels of the trucks would bump as they passed over them and come down upon them with a blow that would crash through the timber and the manhole. While this method of protection serves for the smaller manhole covers, it is inadequate for the larger ones and all of those which are passed over are crushed in.

(Continued on page 383)

All photographs by Edwin Levick

Jacking up the truck so as to slide the girder, trucks and all, across Park Avenue to the east side of the street



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Austrian military searchlight provided with listening devices for detecting hostile aircraft

Providing the Searchlight with Ears

THE idea of listening posts for detecting the approach of hostile aircraft is by no means new. First the French employed huge megaphones, suitably mounted so as to be readily swung to any point in the sky, as part of the anti-aircraft defenses of Paris. Then the British used similar devices in protecting London, followed by the Italians, Germans, and Austrians. Now such listening posts are employed along the entire line of any front subject to considerable aerial activity.

The combining of megaphones and searchlights, however, is a new variation in listening-post practice. According to the accompanying illustration, the Austrians are equipping their huge searchlights with megaphones in the manner depicted, so that each searchlight is largely directed by the sense of hearing. In this manner, it would seem, the hostile aircraft are detected and spotted by the searchlight in a most efficacious manner.

Blasting Bridges to Hamper a Pursuing Enemy

ONE of the greatest obstacles which an advancing army must overcome is a river, canal, or other waterway. Hence it follows that a retreating foe always seeks to interpose as many waterways between himself and the pursuing enemy forces as possible, and due care is taken not to leave intact bridges or bridging materials near at hand.

Most bridges in the war zone are constantly mined, ready for instant destruction. In the case of some bridges which are not mined, explosive magazines are maintained close by, with fuses and detonating devices. Under no circumstances are the explosives or devices to be removed except for the destruction of the bridges during a retreat.

Airplanes Too Large to be Pushed or Pulled

HOW big is a British Handley-Page bombing plane? The dimensions of this giant type have often been published, but figures seldom mean much to the layman. However, like nothing else the accompanying illustration gives an immediate and comprehensive idea of the enormous size of the British bombing plane which is being employed in fair numbers on the Western front. It shows such a machine being hauled out of its hangar and onto the flying field by a gasoline tractor, while the crew is on board ready to start on a raid far in the rear of the German lines.

Experiments in "Flourless Bread"

SEVERAL German newspapers have printed under the title "flourless bread" reports of experiments in making bread direct from the grain without first grinding it to flour. This is done simply by soaking the grain in water and kneading it. The expectations of obtaining a large quantity of bread in this way have not been realized. From 100 kilos of grain, 98½ kilos of flour are obtained, 1½ being lost in the form of dust. Using the grain itself, soaked in water, would therefore at best save 1½ per cent. Even then what might be gained in weight would be lost in nutrition, as the bread made of grain would contain many impurities which are taken out in milling.

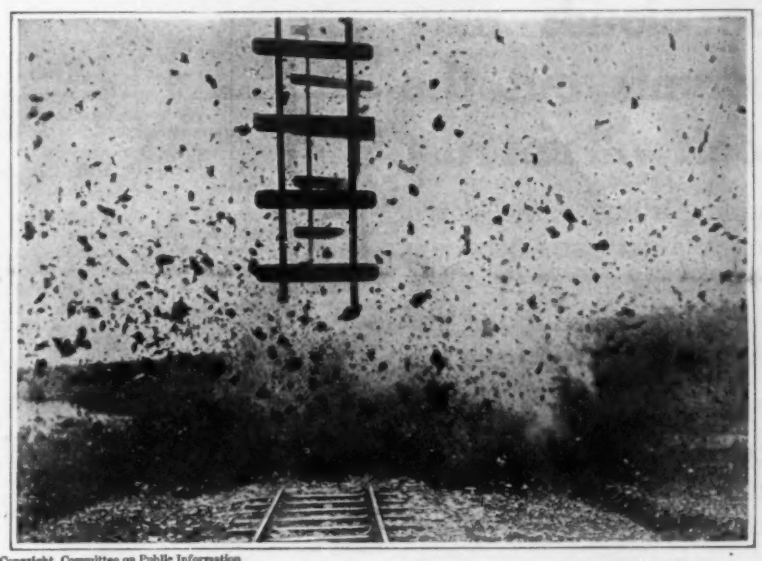
Steel protection for the rifleman's hands, which permits of full freedom of action

Hand Armor for the Rifleman

THE one part of the soldier's anatomy which must be in good order if he is to engage effectively in actual combat would seem to be his hands. Yet no effort has been made to protect these necessary members. While almost every other part of the body has been provided with shelter of some sort, the hands alone are left at the mercy of hostile bullets and bayonets. A very slight impact here may quickly put a soldier *hors du combat*.

Impressed by this fact, T. H. Gavin of Natick, Mass., has invented a hand armor for use with the rifle. He is particularly proud of the degree of freedom which this little device gives its user. All the regular evolutions of rifle and bayonet drill can be performed with complete ease by a man wearing these protectors, and they are so designed as to give him a maximum of defended area at all times. The rifle can even be taken down, cleaned, and put together again without any inconvenience by a man fitted with the hand armor, as the inventor himself has adequately demonstrated.

Equipped with this hand armor, a drill master goes through the entire manual of rifle practice



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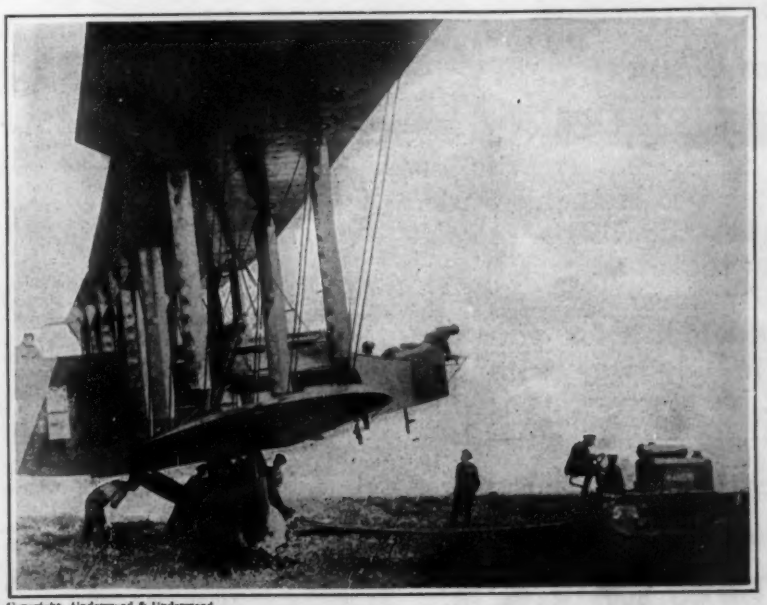
Blowing up a railroad bridge to impede enemy movements

The Current Supplement

WHEN certain insects and animals are suddenly seized they frequently become perfectly immobile, or, as is often said, they "play dead"; and it has been usually supposed that this conduct is intentional, and assumed as a protective measure, although, until recently, no particular study has been directed to the subject. A French scientist has, however, recently made an extensive investigation of the phenomenon, a most interesting account of which will be found in a paper entitled, *Why Animals "Play Dead"* which appears in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2236, for November 9th. One of the most important crops of the world at any time is cotton, and particularly so at this time when so much of it is required in the production of explosives in addition to clothing and a great number of other purposes. Something of the cotton crop in this country, which is one of the largest producers, is told in an article entitled *King Cotton Has Come Into His Kingdom*, which is illustrated by a number of attractive pictures. The paper on *The Principal Bridges of the World* is concluded in this issue. *A Study of Dogs as Carriers and Draught Animals* deals with the important practical question of how these useful animals, that are performing most valuable service in the war, should be harnessed. It is accompanied by a number of excellent photographs. *The Preservation of Decaying Stone* discusses a problem of considerable importance in connection with the conservation of ancient monuments and buildings. Other articles of importance include *The Way of a Ship at Sea; A Study of Percentage Solutions; The Theory of Cyclones; Sandfly Fever or Influenza, The Sensibility of the Eye to Light of Different Colors, Crossed Nerve-Paths Explained, Co-ordination of Chemical Abstracts in Germany, Influence of Carbon Monoxide on the Velocity of Catalytic Hydrogenation of Oils, Carilons, Electrolytic Iron and Nickel-Iron, Quassia Extract as a Contact Insecticide, Methods of Rapid Nickel Plating*, and *The Rapid Cure of Hysterical Symptoms in Soldiers*.



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Hauling a Handley-Page bombing plane out of its hangar

Our Rapidly Expanding Balloon Corps

OWING to the increased demand from the American Expeditionary Forces for balloon crews, the Balloon Corps of the Army is to be increased 25,000 men and 1,200 officers. It now numbers approximately 11,000 all ranks. Authority has been obtained by the Air Service from the General Staff to induct men of draft age and to transfer officers from the other branches of the service.

This increase will create many vacancies in the grades of colonel, lieutenant-colonel, major, captain, and lieutenant. Enlisted men and civilians who apply for officers' examinations will be required to take the cadet course of from three to five months, and training camps for this purpose will be conducted this winter in the South and on the Pacific coast. The schools already established for this purpose are located at Old Point Comfort, Va.; San Antonio, Texas; Arcadia, Cal., near Los Angeles.

In addition to the important role played by the balloon in the control of artillery fire, it is now being used with infantry, a caterpillar mount for the winch permitting the balloon crew to move up over any kind of terrain in company with advancing infantry. Thus balloon observers are now available for advancing infantry.

In addition to the opportunities for immediate promotion, officers who join the balloon service will receive the benefit of flying pay when they actually do the work of observers and make flights in connection with Army operations.

RECENTLY PATENTED INVENTIONS

Of General Interest

ENVELOP.—H. K. KISO, 15-21 Park Row, New York, N. Y. The object of the invention is to provide a construction which may be arranged to act as a second class envelop while open or as a first class envelop when closed. A still further object is to provide an envelop and form the flaps in such a manner that a single stamp will seal a plurality of flaps together.

BRICK MOLD.—F. P. BUNKER, North Manchester, Ind. This invention relates to a collapsible brick mold, the object of the invention is to provide a mold which allows the use of a series of bottoms to the mold with one set of walls and partitions so that bricks may be molded and left to cure and harden on the bottom of the mold, while the rest of the mold is being refilled on another bottom, thus the side walls, end walls and partitions can be used over and over again to mold new bricks when mounted on fresh mold bottoms.

HAND BAG.—A. J. SCHEUER, care of Herman Scheuer & Sons, 171 Madison Ave., New York, N. Y. Among the principal objects which the invention has in view are to furnish a carrying receptacle in the form of a hand bag, for wound yarn or thread provided with means for freely drawing the yarn or thread from the receptacle when the same is otherwise closed, and to adapt a carrying receptacle for articles of personal use for carrying and dispensing wound yarn or thread.

AUTOMATIC GRINDSTONE DRESSER.—F. E. RILEY, Livermore Falls, Maine. This invention has particular reference to devices for dressing or truing the curved surfaces of large grindstones, such for instance as are used in the manufacture of pulp for paper in which operation blocks of wood are subjected under heavy pressure to the abrading action of the surface of a rapidly rotating grindstone. In order to keep such stones in proper condition it is neccessary to give them frequent attention and re-dressing and the prime object of this invention is to provide means whereby the operator may true the stone accurately and quickly.

CONCRETE MOLD.—A. FAGERLUND and E. SUNILA, address Emil Sunila, 849 Forty-second St., Brooklyn, N. Y. An object of the invention is to provide a mold formed of sheet metal, and designed for molding columns and the like in concrete buildings or separately. Another object is to provide means whereby the thickness of the mold may be readily adjusted, and means for adjusting the connection between the head and the main part whereby the same ornamental head may be produced on both large and small columns.

SPRAY POLE.—W. H. GILL, Grandview, Wash. The invention relates to a spray pole for use in spraying trees, its object is to provide a pole which can be turned without turning the hose leading to the nozzle, and which can be manipulated from a distance of six to eight feet from the nozzle. The device comprises a chambered member at the end of the pole, a nozzle connected with the chamber member and disposed obliquely to the same, a tubular member housing the chamber member and pole are connected to the nozzle to revolve therewith.

SHIP'S ENGINE ROOM SIGNAL.—O. K. BOGSTRAND, 179 Carroll St., Brooklyn, N. Y. Among the principal objects of the invention are to provide a signal with means for indicating automatically on the bridge of a vessel, the direction of rotation of the propeller shaft and approximately the rate of speed of rotation, to provide means for varying the operation of the signal, and means audible and visual for detecting and announcing the failure to comply with the command transmitted by the navigating officer to the engine room of the vessel.

PICKING BAG.—E. WOODRUM, Glencoe, Wash. The invention relates especially to apple-picking bags. An object being to provide a bag having a mouth which is held open by a metal loop at its upper end, and the lower end being open but provided with a drawing string by means of which it may be drawn together, and having a hook secured to the metal loop through which the string may be passed and firmly secured, thereby permitting the bottom of the bag to be raised and fastened at any position.

CONSTRUCTION OF TENTS.—P. E. CARRELL, Adelaide, South Australia, Australia. The primary object of this invention is to provide an improved shelter-tent adapted for military, expeditionary and exploratory purposes where extreme compactness and lightness, consistent with weather efficiency and facility of manipulation in erection and dismantlement, are matters of vital importance.

DISPLAY RACK.—J. F. DARLING, 1133 Broadway, New York, N. Y. The invention has particular reference to display racks for large rolls of linoleum, oilcloth, carpet, matting or the like. Among the special objects of the invention is to provide an apparatus of the character indicated for the purpose of holding a considerable number of independent rolls of heavy materials from each of which rolls the goods are adapted to be unrolled without danger of damaging the ends of the goods.

DUPLEX FLASHING BLOCKS.—F. D. RENAUD, 545 31st St., Chicago, Ill. This invention has for an object the provision of an arrangement which may be used with a vertical wall, chimney, skylight enclosure and the like without injuring these members, while providing a proper connection between the various members. A further object is to provide a flashing arranged so that a part will be above the surface of the roof, and will form a durable weather proof connection between the roof and the building walls at a minimum cost in installing.

DISH WASHER.—M. DAS. DUARTE, 92 State St., Boston, Mass. An object of this invention is to provide a simple, convenient and inexpensive contrivance which can be easily manipulated and which is not bulky, which contains a revoluble container for the dishes to be washed and having compartments to prevent accidental damage to the dishes during washing. The device consists of a cylindrical basket comprising a series of circular wire rings, wire members uniting the rings through one-half of their curvature, and a wire cover engaging the other half.

ANCHOR.—P. L. E. DEL FUNGO-GIERA, 144 Harrmon Ave., Pelham Woods, Pelham, N. Y. The invention relates particularly to anchors for buoys, floating mines, and submarine supply containers, the main object is to provide an anchor which combines the advantages of the gravity, the mushroom, and the ballasted types, whereby the mooring of either floating or submerged objects is positively insured regardless of weather or water flow conditions.

STENOGRAPHER'S NOTE BOOK HOLDER.—P. PRATT, 50 Church St., Hackensack, N. J. The invention has for its general objects to simplify the construction and operation, whereby a stenographer's note book will be held in a convenient manner while transcribing notes to a typewriter, the device is inexpensive to manufacture, and so designed as to hold a note book in such way that the leaves can be easily turned and properly held.

WRITING IMPLEMENT.—H. J. MEIER, 216 E. 60th St., New York, N. Y. The object of the invention is to provide a writing implement especially designed for lettering purposes and arranged to enable the user to quickly write letters of the alphabet, or numerals, in heavy type with the aid of a lettering templet. The device comprises a funnel having a spout and provided with a handle, a flow regulating pin, and means for slidably securing the pin to the funnel and a flow retarding means.

FORK.—J. HOTHAM, Fort Pierce, Fla., R. F. D No. 1. The invention has for its object the provision of a fork with removable tines and a locking structure, whereby the tines may be separated and then locked in their proper position for use. By providing means for separating the tines each may be surrounded by a wash cloth and drying cloth thus creating a sanitary construction capable of easy cleaning.

ARTICLE HOLDING ATTACHMENT FOR THE ARM.—W. B. NICOLL, Fort William, Ontario, Canada. This invention relates to an attachment adapted to be worn on the forearm by clerks, salesladies, pupils and others, for holding pens, pencils and similar articles in a convenient manner always available for use, and the attachment also includes a pen wiper and cushion for pins. The device can be easily applied and conveniently worn adjacent the wrist.

ATTACHMENT FOR COLLAPSIBLE TUBES.—R. L. WILLIS, 826 State St., Portsmouth, N. H. The invention relates to collapsible tubes which are employed as containers for various substances such as paints, pastes, powders, etc.; it relates more particularly to means for controlling the discharge orifice of the tube. An object is to provide a cut-off for the discharge orifice to make it possible to do away with the usual screw cap, the cut-off being entirely enclosed within the tube but controllable from the exterior thereof.

CLOTHES PIN.—J. P. KOOB, Sunapee, N. H. The invention has for its object the provision of a clothes pin which requires a minimum amount of material, while accomplishing the same result as a large pin, it is a round pin of substantially the usual appearance but with notches for receiving the clothes line and slits in the lower end for producing a number of resilient clamping fingers or sections whereby the pin may more easily conform to the shape of the clothes line and the clothes placed thereon.

CONVERTIBLE RAFT AND THE LIKE.—S. M. JOHNSON, Cardiff, Wales. This invention relates to a structure adapted for use alternatively as a ship's life-saving raft or a deck-fitting, constituting a canopy-seat, alcove or shelter for passengers on shipboard, the object being to provide a structure which while capable of being secured on deck close to the bulwarks, can be readily cast loose and without further preparation thrown overboard, where, being self-righting, it will at once constitute a raft for the accommodation of passengers.

PROJECTILE.—G. J. KOWALSKI, Detroit, Mich. The invention relates generally to projectiles to means therein calculated to assist the aerial flight. The object is to provide means whereby to avoid the usual retarding vacuum at the rear square end of a projectile, and to do this in a manner permitting the ordinary action of the propelling charge within the gun with maximum effect.

BOTTLE CONTAINER.—W. F. KRUEGER, Morgan, 22d St. and Canalport Ave., Chicago, Ill. The objects of the invention are to provide a box for holding bottles, such as beer and soda bottles, to accommodate the maximum number of bottles in the minimum space, to provide a box in which the bottles will be held sidewise, whereby to maintain the corks or stoppers moist for preventing entrance of air and the spoiling of the contents, to provide a box in which the bottles will be securely held and readily assembled, and to retain the bottles in position and prevent their breakage.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Farms For Returned Soldiers

(*Continued from page 373*)

involving the drainage of swamp land or the clearing of cut-over land; and each will find such a project awaiting him within a few hundred miles of his own former home.

But the plan goes further. In addition to providing work, it affords an opportunity for the returned soldier to acquire a home of his own on the reclaimed land. Besides building the dams, canals, and irrigation ditches, clearing and leveling the land, constructing drainage ditches, erecting houses, barns, and fences, he will be given a preference right of entry on these same lands which he has made ready for the plow, with the privilege of paying for the home which he has made in long-time payments of 30 or 40 years at a low rate of interest. Necessary live stock and farm implements will also be provided by the Government to be paid for in small payments, extending over five to ten years. The element of charity or bounty does not enter at all. It is a straight business proposition.

Group settlements, containing numerous town sites, surrounded by small 40 or 80 acre farms, will be a feature of the plan, so that the objection to the isolation of country life will be largely obviated.

A Survey of Our Land Resources

This in very general terms is the plan for providing work and homes for the returned soldier through the reclamation of our unused lands. Naturally a thousand details must be worked out in advance of their return. The first necessity of course is a complete survey of our land resources, and this work is well under way. The entire work of preliminary investigation into the location and method of acquisition of these lands and the approximate cost of construction of the scores of projects involved, has been placed in charge of Mr. A. P. Davis, Director and Chief Engineer of the Reclamation Service. Under him are three principal assistants, in charge of the western, northwestern, and southeastern sections of the United States, as indicated on the accompany map.

Mr. F. E. Weymouth, the present Chief of Construction of the Reclamation Service, is in charge of the preliminary investigation of the new irrigation projects and incidental drainage projects in the 17 so-called arid and semi-arid States with the exception of the eastern parts of North Dakota, Nebraska, Kansas, Oklahoma and Texas, which are humid and contain drainage problems complicated with the States east. His office is at Denver.

Mr. F. W. Hanna, a former project manager and consulting engineer of the Reclamation Service, with offices at Des Moines, Iowa, is in charge of the northeastern section of the country, comprising largely cut-over timber lands, with some swamp lands.

Mr. H. T. Cory, an engineer formerly connected with the Harriman interests, who gained wide distinction some years ago controlling the Colorado River when it threatened to flood the Imperial Valley in California, has been placed in charge of the southeastern section, which contains the bulk of the cut-over lands and practically all of the swamp lands. His office for the time being is in Washington, D. C.

In addition to the above is Dr. Elwood Mead, who labored so untiringly and with such signal success in solving the social settlement problems in Australia. Dr. Mead will give particular attention to similar problems of settlement here.

These men and their assistants are in the field, making surveys, and in general working up a mass of data to be presented to Congress next year.

Congress and the country as a whole have already indicated their approval of the plan of reclamation, not only through the enactment of legislation providing an appropriation for a preliminary investigation of our latent land resources, but through scores of letters and newspaper editorials endorsing the plan in the highest terms.

We Must Feed Europe

In brief, we know, in a general way that we have approximately 200,000,000 to 250,000,000 acres of at present unused land, which can be made as productive as any agricultural land in the world. We are told by Mr. Hoover that Europe will face a food shortage for years after the war is over, and that for ten years after peace has been declared the productivity of the United States will be called upon to supply the necessary foodstuffs to the millions of hungry people in foreign countries. We know that intelligent industrial direction of our returned fighting men is absolutely essential if many of them are not to become an economic liability instead of an asset. The opportunity is ours, if we will grasp it, to bring the land and the soldier together, to provide work and homes for hundreds of thousands of American citizens, to furnish a supply of foodstuffs sufficient for our growing population and the needs of Europe, and to start a "back-to-the-land" movement which will rival any similar movement ever before thought of in the history of the United States. Can it be done? I believe it can.

This is only part of the story, for in every state there is a great body of other unused lands, now privately-owned, which should be put at the service of the work, and out of this present plan there should be evolved a method for handling these lands so that tenancy would decline and the small farming community be made an attractive social center.

Strategic Moves of the War

(*Continued from page 374*)

Buzancy and Dun-sur-Meuse in the direction of Stenay. This theater of the war operations is the hinge of the German lines from Ghent all the way to Verdun and Metz. It is here that German resistance is most stubborn for delay, in view of the importance of standing off the Allied forces until the armies to the north and west can find possible safety and rest behind the Meuse River lines.

While discussions on an armistice are kept up, the Allied commanders are thus continuing to crush or drive back the German armies at all points; when the time comes shortly, the Entente demands will become more and more plain as the German situation becomes worse and worse. It cannot be long before the German commanders will decide whether they will attempt to hold the Antwerp-Brussels-Namur-Mézières line, whether a stand will be made along the Meuse throughout its length to Verdun or whether they will go back entirely to their own territories. In the latter case their front will be immensely shortened, bringing it more into consonance with their limited resources as regards men, guns and material. By such a move something could be done also toward sorting out and placing their new armies and bringing up such reserves as might be available. As regards men, the Germans are reported as having now on the western front one hundred and sixty divisions, reduced in strength but still available for service; 30 of these divisions are in the general reserve. The losses have been enormous since the spring campaign began, totaling one and a half millions of which 500,000 are permanent.

Considering the extent of their present retreat in every way, it is being wonderfully well managed; it is pivoted on the northern end of the Argonne forest and on the heights of the Meuse River; as it swings back in the north, full use in its successive steps is made of the rivers and waterways of northern France and Belgium. Just now it has been the line of the Scheldt by way of Valenciennes and Guise on to the Champagne country. Soon it will be through Mons and Maubeuge to Hirson following the line of the strategic railway. Later it will no doubt be the line of the Meuse from the Dutch border through Liège, Namur to Mézières, Montmédy, and Metz. All this is based upon the supposition that no sudden breakdown on the lines occur in any section. At any rate, the enemy must not be held too cheaply for he is not yet by any means beaten. The terrain to the north and east, wherever a retreat may be made from the present positions, constantly improves for defensive purposes in view of steadily rising ground, cut up by streams, where tanks cannot easily operate and where fighting on the defensive is certain to be strong. Heretofore, the season for fighting would be nearly over by this time because the weather usually becomes very bad in November and December; the latter month has ordinarily seen the end of operations until spring sets in. If the same conditions hold this year, the Germans will have an opportunity to rest and to reorganize their forces. A great deal depends on the severity of the coming winter; exactly how far the Germans will retire also depends largely on that circumstance. They have been depending upon bad weather, so that every action has been a delaying one. They are fighting from behind streams and all other natural barriers and have held on as long as possible. When forced to give way, the same methods have been employed farther to the rear. This has gone on for weeks and, unless an armistice is granted, it will no doubt continue until winter puts a stop to Allied attacks.

French troops in Serbia have reached the Danube at several places and have interrupted river transportation at Widin, Lom Palanka, etc. There seems to be a certainty that Belgrade will be retaken at an early date and that a new battle front will be presented soon on Austria's southern border. The Serbians are moving north-northwest down the Morava River toward the Danube and along the railroad to Belgrade, where their guns will soon be heard across the Save in Slavonia as well as across the Danube in Hungary. Durazzo on the Adriatic was recently captured by the Italians; the retreating Austrian forces must now retire through the hostile country of Montenegro and through practically a hostile Bosnia and Slavonia. Whether these forces can get back safely to the Danube is a serious question for they are undoubtedly threatened both in the rear and on the flanks. The end may be a military disaster. Austria appears to have lost all fighting spirit and to be facing serious internal revolution. Whether the

blow comes from within or without, it would seem as if the Empire was doomed to disruption and to an early downfall of the Hapsburg dynasty that has ruled the country for so many years. The Serbian forces have already recovered at least three-fourths of their own country and will soon be masters of all. The Allied troops are not far now from the borders of Bosnia and Herzgovina, formerly united to Serbia and peopled almost entirely by Serbians.

By reaching the Danube the French here closed the route by water between Turkey and Austria and have thus isolated the former from her allies except by communication across the Black Sea from Odessa in Russia or from Constanza in Rumania. Everything points to an early abandonment of Rumania by the Central Powers. A demand has been made by our President that Germany must disarm and surrender to the Entente Allies; it must therefore be very plain to Turkey that she can gain nothing by relying further upon Germany and she will therefore probably surrender at discretion. Not only has Turkey been cut off from the Central Powers by the French reaching the Danube; but communication has thus been opened up with Rumania which will undoubtedly soon throw off its German conquerors and will begin with an army of five hundred thousand men and with Allied assistance a new invasion of Hungary that will certainly be crowned this time with success.

After months of inactivity an attack in force was made on the 24th by the Italian, British and French forces in the country between the Piave and Brenta Rivers toward the northern part of the battle lines. The front over which the attack was made was about twenty-five miles in extent. The place selected for the attack would indicate that the present operations are only preliminary to a strong offensive in this region. It will be recalled that for some time it has been rumored the internal conditions in the Austrian Empire had reached such a pass that Austria stood ready to give up all occupied lands held by her in order to convince the Entente Allies that she really meant to sue for peace. It is therefore possible that the Allied commanders have made the present move to hasten Austria's decision. It is more than probable that Marshal Foch has directed the movement in order also to begin a diversion on the eastern end of the line, trusting that ultimately the attack might develop into a major operation that would compel the Austrians to evacuate all the territory held in Italy and to do this quickly. The Italian offensive is directed at a vital portion of the Austro-Hungarian lines between the Piave and the Brenta, viz., the section of Monte Tomba, Monte Grappa and the Asiago Plateau. Should the Italian commander be able to drive north on the front, he can cross the upper Piave and reach the important railway station of Feltre where the railroad supplying this part of the Austrian lines comes down from Belluno. If in addition he can split the connection between the Austrian armies on the Asiago Plateau and in the upper Adige region and those on the eastern bank of the Piave from Montello to the mouths of the river or if he can even threaten such a break, the Austrians must retreat at once out of northern Italy. An immediate withdrawal of the Austrians would seem to be the assured result of any pronounced Allied success on the front now attacked. In the present demoralized condition of the Austrian forces in Italy, it is not believed that any strong resistance would be offered to a powerful offensive. In view of the success of the Italian arms on the other side of the Adriatic in Albania, and the consequent evacuation of both Albania and Serbia by the Austrians, it would seem that Italy could never be better situated to take advantage of Austria's weakness; it is more than probable that Italian troops have been or can be spared from the Albanian front to participate in an advance against Austria from the northern front.

Now that the hot season has passed, news comes of further advances by the British forces up the Tigris toward Mosul. The latest reports speak of movements of the troops against the Turks north of Kerkuk which is on the main caravan route paralleling the Tigris on the east and reaching it at Mosul. It is also evident the British are pursuing the enemy north of Bagdad by routes both east and west of the Tigris and also by the caravan road. Kerkuk is only 60 miles from Mosul so that the fall of that city can be reasonably expected at an early date. Since Aleppo in Syria has been captured, the only line of retreat for the Turks on the Tigris will be up that river to Diarbekir or to Van where the Turkish forces retreating from Persia will probably assemble. The route would then be over the Taurus mountains to Erzerum and Trebizond; but, if caught in the mountains in winter, the retreat will undoubtedly become a rout. In any event, as our map shows, the Turks are in a nasty hole.

The capture of Aleppo by the British forces from Palestine is the crowning event of the campaign in which Jerusalem and Damascus have been taken on the way north. At or near Aleppo, the railway from Constantinople branches off, one line going south into Palestine and the other continuing east to Mosul and thence south to Bagdad. The city was the Turkish base of operations for the campaigns against the Suez Canal and also down the Tigris to Bagdad and the Persian Gulf. With Aleppo in the hands of the British, the Turkish armies operating in Mesopotamia have their lines of supply cut and must retreat into Armenia as stated above. From that city, the British can also move forward into Asia Minor and can go even north to the Black Sea. It is more than probable, however, that their first move will be to Adana just east of the Cilician Gates where the railroad runs nearest to the Gulf of Alexandretta and the Mediterranean. With the capture of Aleppo all Turkish military power is absolutely broken in this part of Asia; all Turkish territory east of the Taurus mountains is forever lost to Turkey.

Armenia, Syria, Mesopotamia, Palestine, and Arabia are finally freed and will be permitted to establish stable governments of their own choosing.

The New Approach to Grand Central Depot

(*Continued from page 378*)

On one occasion, a wheel broke into a large manhole short-circuiting many electric high-tension mains with the result that there was, immediately, a brilliant pyrotechnic display. The smaller manholes, even though they are crushed by the trucks offer little obstruction to the hauling because the momentum of the big load carries the wheels over the manhole before they can sink in to any extent. In the case of the larger manholes, very considerable difficulty is encountered, and it is usually necessary to jack up the trucks before the wheels can be hauled out of the hole.

There are eight girders in the viaduct, most of which have been placed in position at the time of writing, and as the streets through which the load passes must be closed to traffic for a considerable period of time, it has been necessary to do the hauling either at night or on Sunday.

An interesting piece of work is that of turning the huge girders at 23d Street and Fourth Avenue so that they can pass up Fourth Avenue to 42d Street. An object 135 feet in length has to be manuevered rather carefully in order to swing it around a corner without smashing into the buildings. The method pursued is to haul the girder past Fourth Avenue on 23d Street, then to swing the forward truck around at an angle and connect it by means of tackle to a "dead man" placed on Fourth Avenue. The lamp posts and hydrants at the corner have to be removed so as to permit the girder to swing around. Horses are then attached to the tackle and by pulling the truck back, the rear end of the girder is backed around into Fourth Avenue south of 23d Street, while the forward end is pulled into Fourth Avenue north of the cross street. At first it was attempted to do this work without the use of the tackle by the direct pull of the horses, but it takes a long time to get 52 horses to pull together and it is impossible to control them perfectly. when this was first tried, owing to an error in positioning the forward truck, the overhang of the girder crashed into one of the buildings tearing out a doorway and some of the stonework before it could be stopped. For this reason, it was decided to use pulleys and tackle so that the movement of the girder could be controlled more easily. At first it took two hours to round the corner, but as the haulers became practised at this task, the time was cut to 30 minutes.

As we have explained above, there is a ramp only on the western side of Fourth Avenue where it runs up the hill to Park Avenue. Park Avenue is separated into an east and west side roadway by means of garden plots and ventilation openings to the tunnel below. The girders are hauled up the west roadway until they reach the south end of the viaduct. Then those which are to carry the east side of the viaduct are transferred to the east roadway by a novel method. Tracks are laid across from one roadway to the other and the trucks are jacked up until the wheels can be placed in skids, which are shown in one of our illustrations. These skids are greased so that they will slide along the tracks. Then by means of suitable tackle, the entire load, trucks and all, is moved laterally across to the eastern roadway. Here jacks are again introduced to permit of taking out the skids and letting the wheels down upon the street.

Taking the load down the hill at 40th Street involves the use of some sort of brake to prevent it from gathering such headway that it will become unmanageable. For this purpose big planks of wood are thrown under the wheels at intervals to check them. The wheels crash through the wood, but at the same time the speed is reduced sufficiently to keep the load fully under control.

Altogether the task of hauling these girders has been conducted in a very masterly way and the work is rapidly nearing completion.

How the Red Cross Saves Gasoline

By R. Michaels

IN France today a dollar will not buy a gallon of gasoline. Ten dollars won't. Gasoline is not for sale.

Even the American Red Cross cannot purchase sufficient for its needs. It has to borrow from the French Government. The latter, while recognizing the vital need of supplying the motor trucks and ambulances of the Red Cross organization with fuel, nevertheless is so situated in regard to gasoline that it can only lend, not sell the precious liquid for even the most urgent purposes.

When a Red Cross driver needs gas he gets it on "carnet." That is, he borrows it on a triplicate order from the French army station nearest. Every liter he uses has to be paid back to the Government by the Red Cross from the stores brought in by American oil tankers.

Joy riding in France is an extinct dissipation. No pleasure cars can be operated. Even Red Cross chauffeurs cannot take a spin out to Passy in their leisure time, for a stern check is kept on every drop of gasoline issued to them.

When a Red Cross ambulance or truck leaves the garage the reading of its odometer has been taken. The amount of gasoline in its tank has been measured to fractions of a liter. The driver has been furnished with written directions, telling him the shortest direct route to and from his destination. He is expected not to deviate a foot from this.

If there is the discrepancy even of a quarter-mile over the estimated distance, or the second reading of the volume of gas in the tank shows that more than the expected amount has been consumed, the driver is called to account instantly. He must furnish a satisfactory written explanation, else punishment follows. For a first offense he is reprimanded severely. For a second he is given three weeks "wash rack." This means he is forced to wash dirty ambulances for three weeks before he can go back to the wheel. In case there is a third offense he is sent as a military offender to the Provost Marshal General at Paris. There he is punished, probably by being dismissed from the service in disgrace.

The efficiency of cars in Red Cross service is not measured in "miles to the gallon." The standard is "blocks to the liter." The odometer's marking of tenths of a mile is called a block. The minimum blockage demanded of cars in the ambulance service is 40 per liter. Since a liter is slightly more than a quart, this means a minimum mileage of 16 miles to the gallon. For extraordinary conditions such as sand, rough roads or mud, which necessitate running more in low and the intermediate speeds, a 30 per cent allowance is made on the minimum blockage.

This demand keeps the drivers busy all of the time, adjusting and readjusting carburetors, grinding valves, and removing the accumulations of carbon from the cylinders. It means constant attention on the part of these men merely to secure the minimum blockage, but so good is their spirit that many cars have been run under difficult conditions and have been kept in such good shape that they have far exceeded the minimum.

The Red Cross has not stopped with the drivers in eliminating waste, however. An exhaustive series of experiments recently was conducted under its supervision to determine how the precious borrowed stores of gasoline could be kept with the least possible waste. Suspicion has been thrown upon the usual system of underground tanks and reservoirs.

The Red Cross found out that steel or iron tanks, when set in the ground for any length of time, were subject to corrosion. Many developed small holes that were wasteful of their gasoline content, hard to detect and very hard to repair, owing to the position of the tank below the surface of the ground.

Surface tanks were adopted. It was found, however, that when exposed to light, these tanks grew warm, and this made the evaporation of the gasoline more rapid than it should be. Painting a number of experimental tanks various colors was tried. Each of the tanks was exposed to the rays of an electric arc at three feet distance, for 15 minutes. The rise, in degrees Fahrenheit for the different colored tanks was found to be as follows:

Aluminum paint	18.6
White	19.9
Green (light)	24.8
Red	28.1
Prussian blue	34.3
Green (dark)	38.4
Black	52.9

Because the temperature of gasoline is a good index of the amount that is evaporating, the volatility increasing rapidly with increasing heat, the Red Cross recommended that either aluminum or white paint should be used on all its gasoline storage reservoirs, and that wherever practicable, the tanks of the trucks and ambulances should be painted in like manner.

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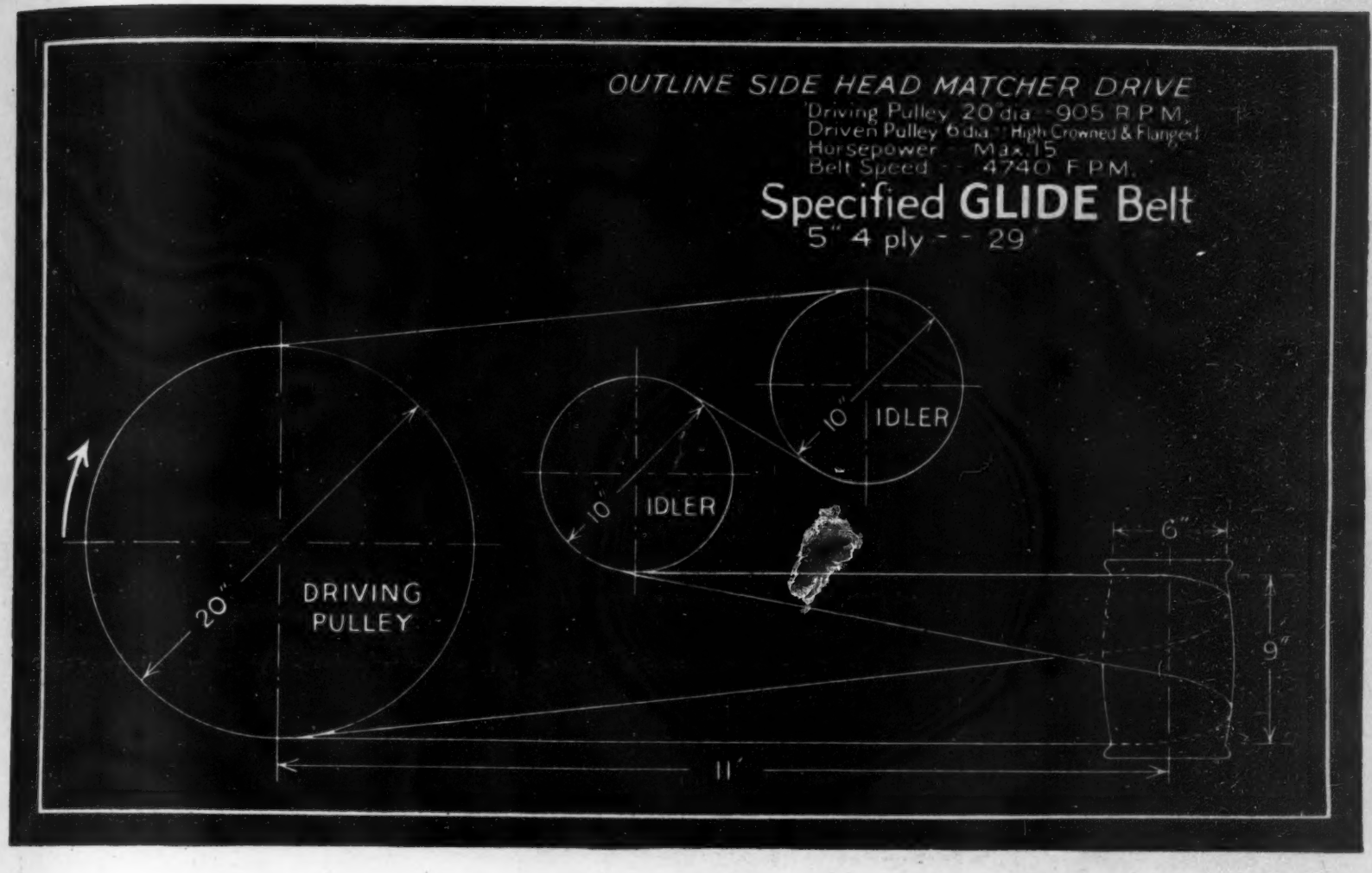

Making $1.00—and the G.T.M.—Do the Work of $3.10

All they were after, the Wilson Lumber Company, of Bokhoma, Oklahoma, told the G. T. M.—our Mr. Heehs—was less interruption and more production from their side-head drive. Mr. Bowles, the Superintendent, asked how much his best belt cost per foot. The G. T. M.—Goodyear Technical man—told them that he didn't know which of his belts was the best. He said that if they'd let him study the drive he'd tell them which Goodyear Belt was best *for it*—that with drives as with men, what is meat for one is poison for another.

He studied that drive and prescribed the Goodyear Belt especially constructed to serve its high-speed quarter-turn and *high-crowned,* flanged driven pulley—not the highest priced Goodyear Belt by any means, nor the one with the greatest brute strength. It was in February and the price of that Goodyear Glide Belt was fifty cents a foot, while the special double they had been using cost $1.55.

If his price had been higher the order he finally got would have come easier. It didn't seem likely to them that a belt costing fifty cents a foot would do better than one costing $1.55. But they decided to give it a trial—they were sick of the troubles and expense of that side-head drive and—at the price they felt that they couldn't lose much.

That Glide Belt gave six months of service, as much as what they had been getting from the $1.55 per foot special double. On account of Glide's friction surface it delivered power better—and it required practically no attention. Six months of inferior service from the discarded type of belting would have cost $1.55—so that $1.00 spent for Glide was as good as $3.10 spent for the special double—and the better service of the Glide was thrown in for good measure.

Over thirty dollars in belt cost alone are saved every six months by that 29 feet of Glide Belt and the analysis service of the G. T. M.—$121.80 a year. When he pointed that out, he told them of the Goodyear plan of Plant Analysis, of having a G. T. M. analyze *every* drive in the plant for the purpose of prescribing the belt best designed to meet the peculiar conditions of each. They told him to go ahead.

They order by telegram now, direct from the Goodyear Branch near them. Goodyear Belts as prescribed by the G. T. M. are releasing dollars from many other drives, reducing interruption and increasing production. If you have a belt-devouring drive that is both imprisoning and eating too many dollars, ask a G. T. M. to call. He'll do it without charge when he's in your vicinity. There are many of them—all trained in the Goodyear Technical School—all with experience in plants similar to yours—all selling belts to meet conditions and not as a hardware man sells nails. We are able to give the G. T. M.'s services free only because the savings they effect for purchasers are so considerable that a gratifying volume of business from the plants analyzed is sure to result within a year or two.

THE GOODYEAR TIRE & RUBBER COMPANY
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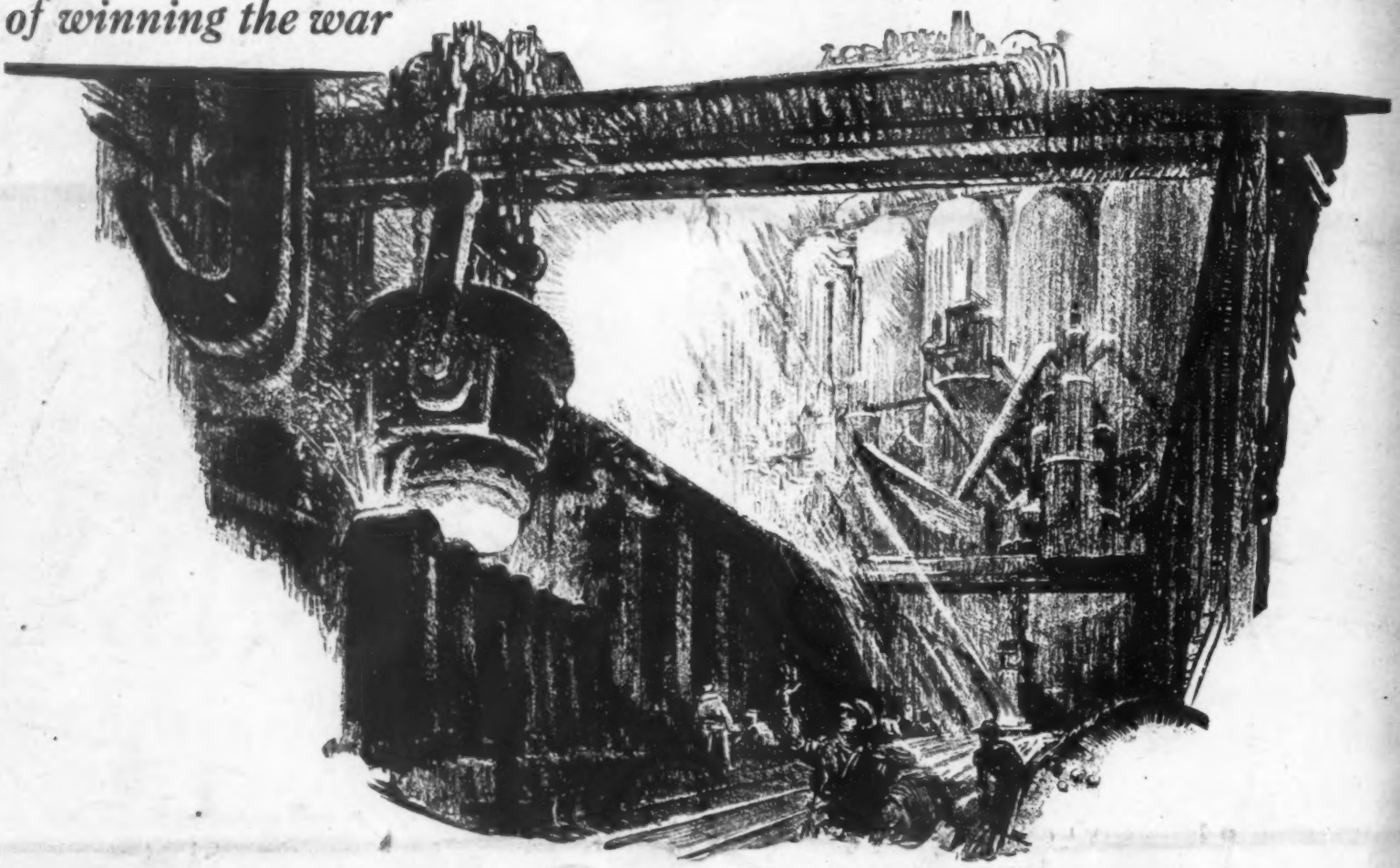

When Steel faced the crisis, Electric Power was ready to aid

Some day, when there is time to tell the history of America's industrial mobilization, the romantic story of steel will be a source of pride to every American.

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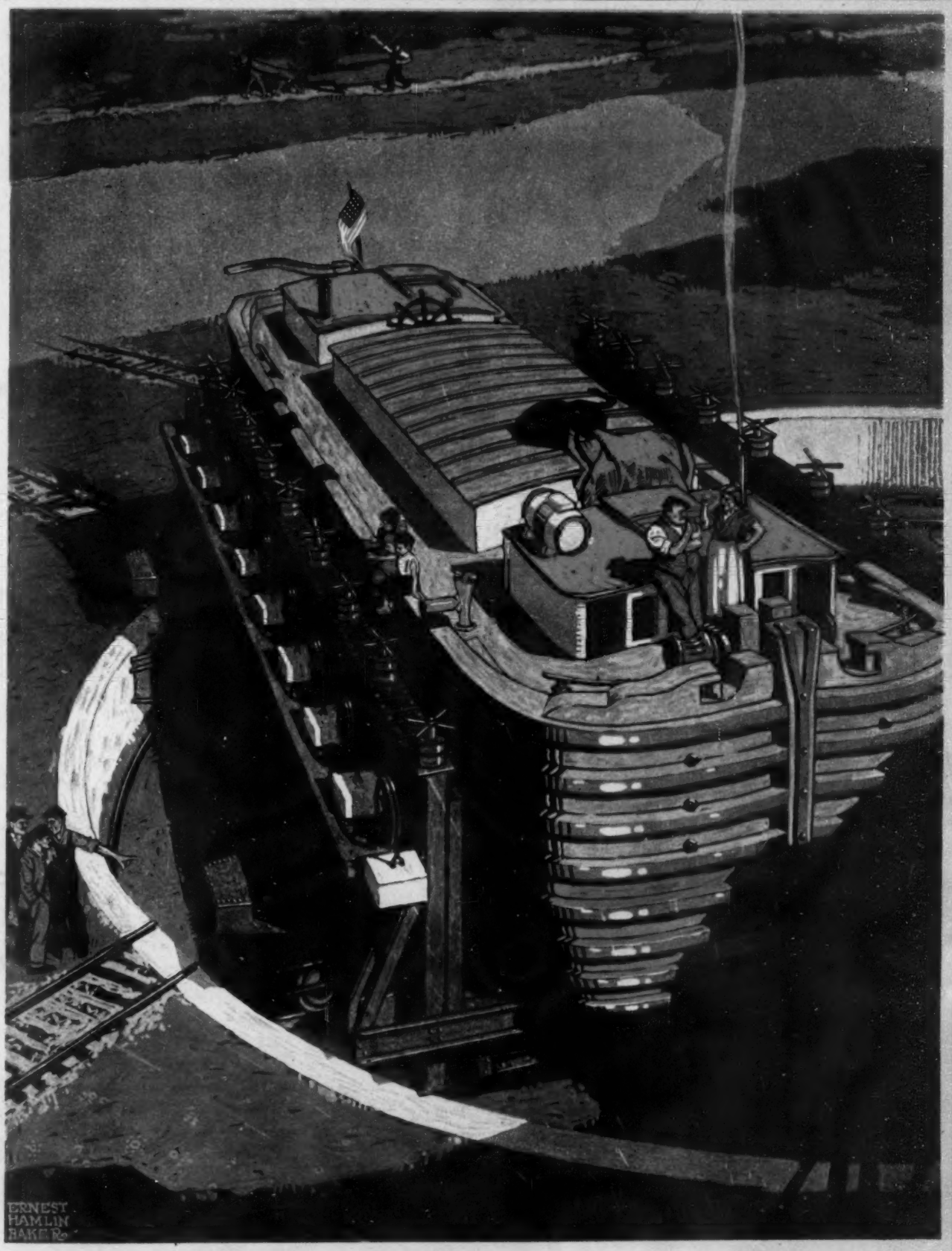

ON THE TURN-TABLE OF THE MARINE RAILWAY AT SPRING LAKE, ILLINOIS [See page 389]

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against the integrity of an assemblage of metal parts and the question of the bearing's quality becomes a definite thing. ¶ And in aeronautics the stake is all that — and more. So the use of bearings in such service becomes the finest testimonial for their makers. In this respect it's interesting to note that Hess-Bright Ball Bearings are fit to serve.

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